Operation Manual

FarSounder-500, FarSounder-1000 and FS-3DT Navigation Sonars

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1. Installation of Shipboard Equipment

Before running the software, it is important that the equipment has been properly installed by the shipyard or electronics integrator. This chapter summarizes the installation process and serves as a guide for the ship operator for confirming proper installation.

Important

To qualify for warranty coverage, the system must be commissioned by a certified FarSounder technician. Installation and Commissioning must follow the guidelines in the latest version of FarSounder's *F31563 Navigation Sonar Commissioning Checklist*.

Your sonar system consists of:

- Transducer Module

- Power Module

- Transducer Module Connection Cable

- SonaSoft™ software

Generally, the equipment is installed by the shipyard and/or electronics integrator.

1.1. Transducer Module Connection Cable

System installation begins with the Transducer Module Connection Cable. This cable is a custom designed to connect a FarSounder Transducer Module to a FarSounder Power Module. The wet end connector can be connected dry or underwater.

The wet end connector should not be left unconnected while wet or underwater for extended periods of time. A wet end connector cap is shipped with the cable for use during extended periods of unconnected wet or underwater use.

This documentation is given as a reference only. This cable is supplied by the Manufacturer and should not be serviced by the end user.

Cable Specification

- Maximum Length: 100 feet (33 meters)

- Approximate OD: 0.8" (2 cm)

- Jacket Material: Water-proof, Low Temperature Polyurethane

- Minimum Bend Radius: 6" (15 cm)

Cable can be cut to length on location. It is recommended that at least 3 feet (1 meter) extra cable length be coiled at the Power Module if cutting to length.

Running the Cable

The Transducer Module Cable should be run through a conduit from the Transducer Module to the Power Module. Because the connector at the Transducer Module is molded onto the cable, it must be pulled

from that location up to the Power Module location. This is best done while the vessel is in dry-dock, but FarSounder can prepare a cable for submersion if requested. A cable puller is useful for this operation.

Figure 1. Cable with puller attached

Preparing the Dry End of the Cable

FarSounder's most current Power Module is a bulkhead mounted enclosure and the connections to the dry end of the Transducer Module Connection Cable are made inside this enclosure. Earlier models had 2U rack mount enclosures. The latest of these models also has internal connections. Older, legacy rack mount Power Modules have a soldered connector. See Preparing the Dry End of the Cable (Legacy Power Modules) for preparation details for legacy Power Modules with soldered connectors.

- Remove about 7.5" (19 cm) of the urethane jacket and braided shield from the end of the cable. This will expose the bundled wires. Be sure not to damage the internal conductors.

- Remove the Power Module cover to access the inside. The current model has four screws at the corners of the access panel. Disconnect the ribbon cable attached to the Power Module LEDs on the cover panel. The later rack mount enclosure has a removable access panel on the top of the chassis towards the rear of the unit.

- Terminate the cable's cat-5e with a standard RJ-45 as described in the following subsections.

- Terminate the cable's coax cable with the supplied BNC connector as described in the following subsections.

- Prepare the remaining conductors for connecting to a terminal strip by stripping the end of the wires.

- Feed the Transducer Module Cable through the larger of the two cable glands. Inside the Power Module the cable connects to the Power Module electronics via standard RJ-45, BNC, and terminal block connections described below.

- Mate the connections as described in the following subsections.

- The ethernet cable to the bridge can also be installed at this time. This connection should be tested for 1 Gbps connection between the Power Module to the bridge computer. Industrial Cat-6 or better is recommended.
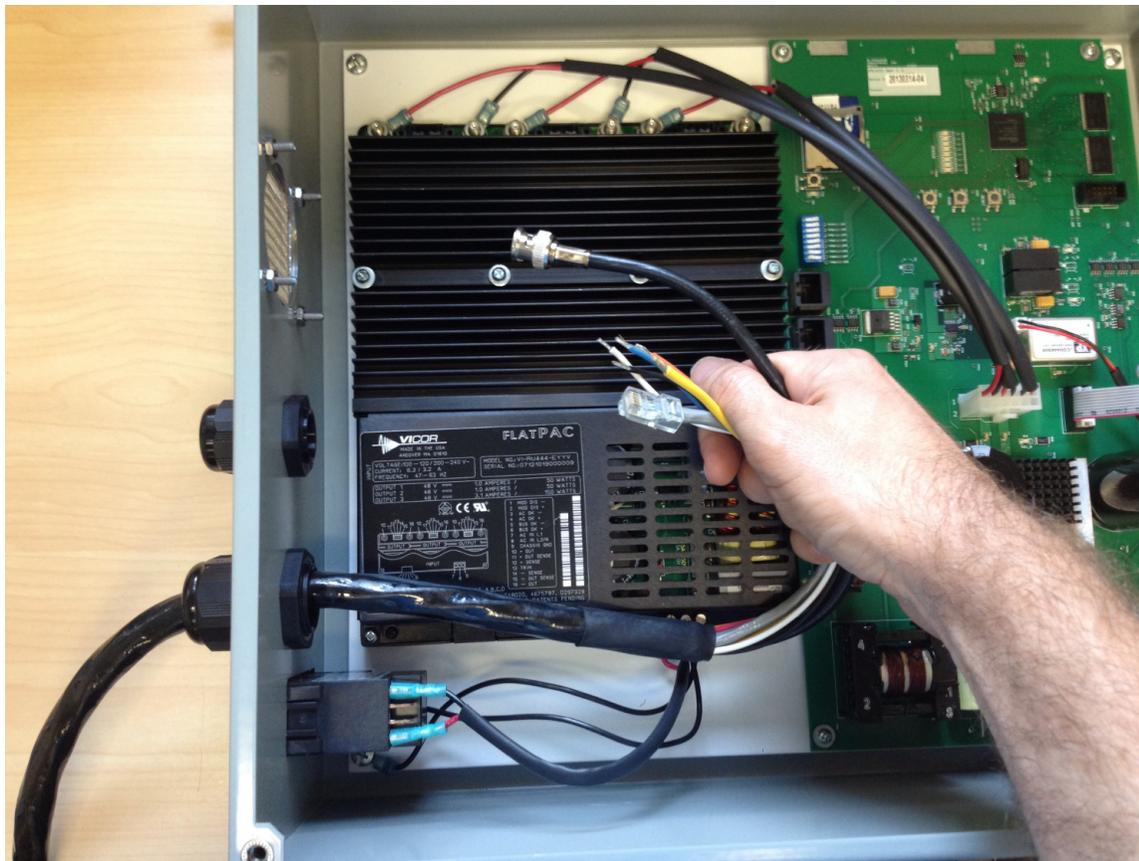
Figure 2. Example termination inside bulkhead mount Power Module
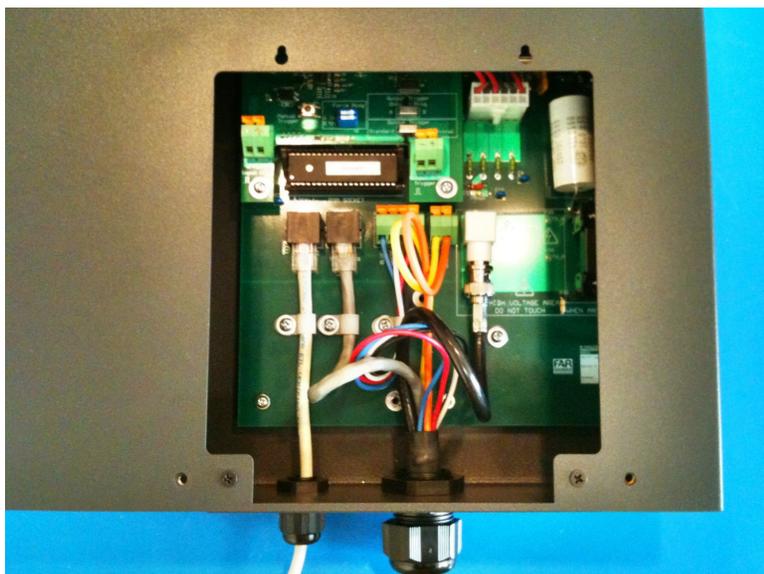
Figure 3. Example termination inside rack mount Power Module

Terminating the Cat-5e Cable

Standard T568B wiring should be used for the Cat-5e cable coming out of the Transducer Module Connection Cable bundle. It is recommended that the Ethernet cable used to connect the Power Module to

the bridge be a standard straight-through cable also using T568B wiring. Use standard RJ-45 connectors on this cable. These connectors are not supplied by FarSounder.

Terminating the Coax Cable

The coax cable is terminated with a standard BNC crimp style connector. There are many varieties of these connectors depending upon the particular cable specifications. FarSounder supplies a BNC connector suitable for the supplied cable with the Power Module. Standard coax preparation tools can be used to strip the coax jacket and conductor. A standard BNC crimping tool can be used to install the connector.
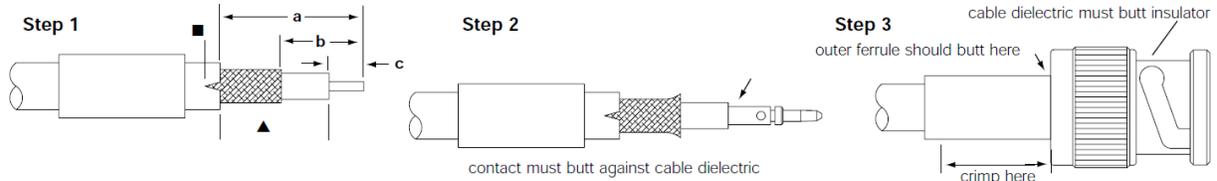
Step 1 Strip cable jacket, braid, and dielectric to dimensions in table above. [for RG-62,71,210/U cable, trim an additional .039"(1.0mm) of insulation off center conductor and add bushing] All cuts are to be sharp and square.
Important: Do not nick braid, dielectric, and center conductor. Slide outer ferrule onto cable as shown.

Step 2 Flare slightly end of cable braid as shown to facilitate insertion of inner ferrule. Important: Do not comb out braid ▲. Place contact on cable center conductor so that it butts against cable dielectric. Crimp contact in place using Die Set Cavity indicated in table above. When using RG-62, 71, 210 cable, install bushing over center conductor before installing contact.

Step 3 Install cable assembly into body assembly so that inner ferrule portion slides under braid. Push cable assembly forward until contact snaps into place in insulator. Slide outer ferrule over braid and up against connector body. Crimp outer ferrule using Die Set Cavity specified in table above.

■ ▲For RG-174, 179, 187, 188, 316/U cables only, slit jacket back .100"(2.5mm) as shown. Before attaching center contact, slide metal spacer/TFE sleeve (not shown) over cable dielectric and under braid. The center contact should butt against the dielectric and TFE sleeve.

* for pneumatic crimp tool 227-60, use die sets indicated in this column.

Figure 4. Crimp terminating the coax cable

Recommended Tools

Listed below are the tools that FarSounder uses though many equivalent tools exist.

Description	Use	Manufacturer	MFR Part Number
Rotary Cable Stripper	Removing outer jacket of sonar cable	Tyco	606700-1
Coax Cable Stripper	Prepping Transmit Coax in sonar cable	Paladin Tools	LC CST 1255
BNC Ratchet Crimper	Terminating Transmit Cable BNC	Tyco	58433-2
BNC Connector	BNC crimp-on connector for RG-59 with 20 AWG stranded center conductor	Amphenol	68175-5RFX

Table 1. Recommended Cable Termination Tools

Connecting the Terminal Strips

Bulkhead Mount Power Module Specific

The six individual conductors are connected to the Power Module using the provided terminal block connectors. Strip 0.25 inches (7mm) from the end of each of these wires, then secure them to the mating connectors per the color codes specified on the circuit board.
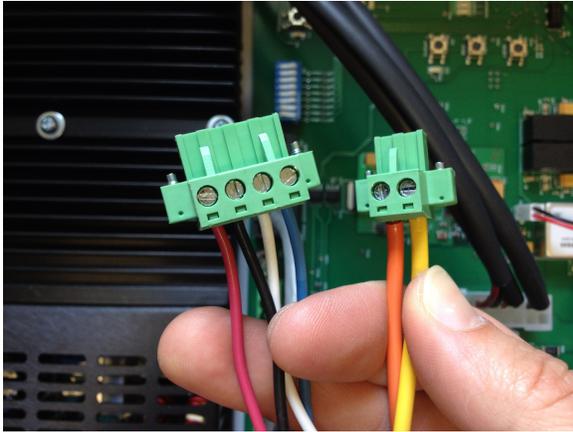
Figure 5. Connecting to the terminal strip connectors

Rack Mount Power Module Specific

Connect the remaining conductors to the circuit board via the terminal strips. The four 16 gauge conductors fit into one terminal strip block. The two 12 gauge conductors fit into another terminal strip block. Follow the color codes on the circuit board to ensure that each conductor fits into the correct receptacle. Note that the 12 gauge conductors fit very snug into the terminal strip block. Make sure that the strands of the conductor are not separated. Otherwise it will be difficult to ensure a proper connection.

Mating the Connections

Connect the BNC and RJ-45 to their respective receptacles on the Power Module's circuit board. Follow the labels on the pcb to ensure that each RJ-45 is connected to the correct receptacle. Prior to mating to the circuit board, allow the cables to be coiled once to remove any strain as they come from the gland.

Figure 6. Minimize strain on wires - bulkhead mount Power Module
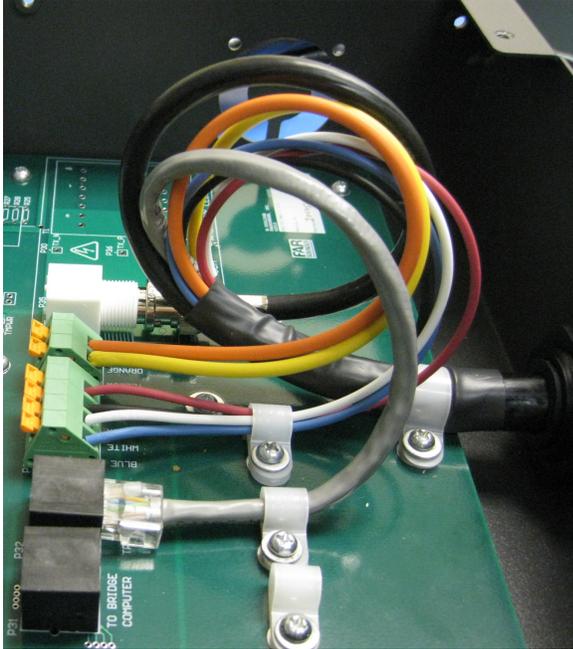
Figure 7. Minimize strain on wires - rack mount Power Module

Preparing the Dry End of the Cable (Legacy Power Modules)

Legacy rack mount Power Modules connect to the dry end of the cable using an Amphenol 97-3106A-24-7P Circular Connector. The cable is supplied with this connector unterminated so that the cable can be run through a conduit that has a smaller diameter than the connector. The connector may be assembled and soldered by a qualified electrician. The wiring diagram for this is shown in table 2. The dry end connector is approximately 2 inches (5 cm) in diameter.

Figure 8. Legacy dry end connector

Amphenol Plug (97-3106A-24-7P)	Cable	Subconn (BH16FSS)
A	RG59 Center	1
B	RG59 SHIELD	2
N	12 AWG YELLOW	3
P	12 AWG ORANGE	4
C	16 AWG BLACK	5
D	12 AWG BLUE	6
E	16 AWG WHITE	7
F	16 AWG RED	8
G	CAT5 GREEN	9
H	CAT5 WHITE/GREEN	10
I	CAT5 ORANGE	11
J	CAT5 WHITE/ORANGE	12
K	CAT5 BLUE	13
L	CAT5 WHITE/BLUE	14
M	CAT5 BROWN	15
O	CAT5 WHITE/BROWN	16

Table 2. FarSounder Cable Pin Mapping

Important

The outer braded shield of the cable is a structural component only. There is no need to connect it to ground.

Wet End Preparation

The wet end of the cable is terminated with a Subconn BH16MSS connector. This connector is molded onto the cable at the factory and cannot be serviced by the user. This connection can be mated in a wet environment or underwater. The wet end connector is approximately 2.4 inches (6 cm) in diameter.

Warning

This connector can be mated and un-mated underwater as long as the Power Module is switched off. If this connector is to be left un-mated in a wet environment or underwater, it is necessary to protect it using the supplied Connection Cable End Cap.

Figure 9. Remove connector cap from cable

Handling

- Always apply grease before mating.

- Disconnect by pulling straight, not at an angle.

- Do not pull on the cable and avoid sharp bends at cable entry.

- SubConn connectors should not be exposed to extended periods of heat or direct sunlight. If a connector becomes very dry, it should be soaked in fresh water before use.

Greasing and Mating

Figure 10.
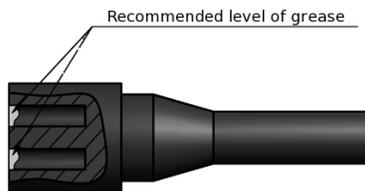
Figure 11.

Follow these directions when mating the wet end of the cable:

- Connectors must be greased with Molykote 44 Medium before every mating.

- All sockets should be completely covered, and a thin transparent layer of grease left visible on the face of the connector.

- After greasing, fully mate the male and female connector in order to secure optimal distribution of grease on pins and in sockets.

- To confirm that grease has been sufficiently applied, de-mate and check for grease on every male pin. Then re-mate the connector.

1.2. Transducer Module

The most obvious component in your sonar system is the Transducer Module. Though different models are supplied with the FarSounder-500 and FarSounder-1000, the installation concepts discussed here are the same for all Transducer Modules. Transducer Modules for legacy FS-3DT products have the same mechanical footprint and installation process as the FarSounder-500.

For typical forward-looking navigation applications, the sonar system consists of a single node installed on the bow of the vessel. Some vessels require navigation sonar capabilities for both forward and astern

navigation. For this application, the sonar system consists of two nodes: bow and stern. In this case, the operator can switch between the two nodes via the user interface software.

Figure 12. FarSounder-500 Transducer Module

Figure 13. FarSounder-1000 Flat Faced Transducer Module

Figure 14. Legacy FarSounder-1000 Curved Transducer Module

Bow mounted Transducer Modules should be installed as far forward and as far below the water as possible on the vessel. The black urethane array face should face forward with a clear view of the water ahead of the vessel. Stern mounted Transducer Modules should be installed such that their field-of-view is not blocked by the vessel's propulsion system. On the face of the unit there is a small protrusion to indicate the 12 o'clock position of the unit. The Transducer Module must be installed with this marking at the 12 o'clock position for proper operation.

⛔ **Warning**

Do not open the transducer module. Injury or death may result. There are no user serviceable parts inside.

The Transducer Module has a single underwater matable connection. This connector is used to connect the Transducer Module to the Power Module via FarSounder's Transducer Module Connection Cable. When properly installed, the face protrusion and the rear connector should be at the 12 o'clock position.

Figure 15. Rear view of Transducer Module

The connector can be connected dry or underwater. Before connecting, sure that the wet end connector on the cable is lubricated as described in Greasing and Mating. If connecting underwater, lubricant may not be necessary.

The wet end connector should not be left unconnected while wet or underwater for extended periods of time. A Connection Cable End Cap (F24557) is supplied as standard for use during transport/installation and extended periods of unconnected wet or underwater use.

Installation

The Transducer Module has been designed to allow for a simple, one cable connection to the rest of the sonar hardware. Twelve holes are located around the Transducer Module's flange to allow for mechanical attachment to the vessel. The connector on the rear of the Transducer Module is capable of a wet mating and un-mating. If necessary, this allows the Transducer Module to be installed and removed from the vessel by a diver underwater, rather than dry docking or hauling the vessel. Here are the primary steps for installing the Transducer Module into a pre-installed fairing mount.

1. Unpack the Transducer Module. Ensure that there is no debris caught in the connector pins.

2. If the installation is done underwater, a blank connector cover should have been used on the Transducer Module Connection Cable's wet end connector. Remove the blank connector cover from the cable.

Figure 16. Remove connector cap from cable

3. Connect the Transducer Module Connection Cable to Transducer Module. Be sure that the connector is fully connected. The black rubber on the cable and the Transducer Module connectors should be flush with each other.

4. Hand tighten the red connector locking collar on the cable and Transducer Module.

Figure 17. Connect cable and locking ring

5. Fix the Transducer Module into the installation mount. Use all 12 bolts if possible. Bolts are not included.

When installing the Transducer Module into your mount, the orientation of the Transducer Module is very important. There is a protrusion on the black urethane face on the front of the unit that should be at the 12 o'clock position. The connector on the rear of the Transducer Module should also be at the 12 o'clock position. As with any piece of bolted hardware, the use of washers and lock washers is recommended.

Important

Do not put caulking (such as Sikaflex) around the Transducer Module. It is important that water be able to flow through the small slits in the installation collar in order to help with system cooling.

Important

For vessels with both bow and stern sonar nodes, the specific Transducer Module to be installed each location are specified by the factory before shipment. This allows the software to be pre-configured for the specific node locations.

Corrosion Protection

The standard material for the Transducer Module pressure case is SS 316. To ensure the longest operational life of the unit, it is recommended that the Transducer Module is not electrically isolated from

the rest of the vessel and that zincs are closely located to the Transducer Module. As with any other piece of marine electronics, it is important to ensure that the Transducer Module does not become anodic (active) relative to closely located materials.

For composite hulls, it is important that the Transducer Module is connected to the ship's ground. This is most easily attained by connecting the fairing's inner mounting ring (generally this is a steel flange embedded into a composite fairing) to the ship's ground.

Additionally, it is recommended that the Transducer Module be electrically connected to zincs. The simplest way to do this on a composite hull is to weld a ground strap from the fairing's mounting flange to a hull mounted zinc plate.

Important

If painting the Transducer Module, be certain NOT to paint the urethane array face. Also, be certain that the paint used will not dissolve, destroy, or otherwise harm the urethane since it is likely that some paint will touch the edge of the urethane array face.

1.3. Power Module

The Power Module for FarSounder's current products is offered in a bulkhead mounted enclosure designed to be mounted in a dry location. Previous products were offered with a 2U rack mount enclosure. The Power Module houses the sonar system's power supplies, transmit signal generator, and power amplifier. As with other shipboard electronics, the unit should be shock mounted where appropriate. Shock mounting will generally improve the lifespan of the unit and should be considered for installation locations that experience extreme shock or vibration. However, this is not a standard requirement.

Figure 18. Power Module (current bulkhead mount configuration)

Figure 19. Power Module (previous rack mount configuration)

The Power Module should be located in a dry location. There are no user interface components on the Power Module other than a power switch. For installation in inaccessible locations, the power input can be put on a circuit breaker line with the switch in a convenient location.

⛔ Warning

Do not open the Power Module or allow it to get wet. Injury or death may result. There are no user serviceable parts inside.

Plugs and Connections

The Power Module has three connections that are necessary for operation: a Transducer Module Connection Cable, a network connection, and a power connection.

The Transducer Module Connection Cable enters the chassis via the large circular cable gland on the side of the Power Module's chassis. The Transducer Module Connection cable is the largest of the cables and requires the most clearance. The Transducer Module Connection cable should have a soft layup entering the Power Module. The minimum cable bend radius is 6 inches (15 cm). Therefore, 8 to 10 inches (20 to 25 cm) minimum clearance at the cable gland outside the Power Module is recommended. FarSounder is not responsible for damage to the cable due to excessive bending. Standard cable/wire anchors or ties can be used to support/secure the cable to any bulkheads or mounting hardware as necessary.

Figure 20. Transducer Module Connection Cable entry into rack mount Power Module

The Power Module is powered by either 110-120 or 220-240 VAC. Total power consumption for the unit is approximately 100 watts continuous. A power receptacle (IEC-320-C14 inlet socket) is used to connect AC mains power to the Power Module. The recptical includes a replaceable fuse, line filter and a master power switch. It is recommended that an Uninterpretable Power Supply (UPS) be used to power the Power Module.

❗ Important

If a replacement fuse if ever needed, the reason for the blown fuse should first be investigated. The replacement fuse specification is: Fast Acting; 6.3A; Dims 5x20mm; Glass; Cartridge; 250VAC; 0.009Ohms.

❗ Important

If the Power Module is located in a location that is not easy to access, it is recommended that a dedicated circuit (with circuit breaker in the main bridge circuit breaker panel) be used for the Power Module. This will allow the user to turn off the Power Module remotely.

The Power Module has a standard RJ-45 plug for connecting to the user interface computer. The Ethernet cable enters the chassis via the smaller circular cable gland. When connecting the Power Module directly to the user interface computer, an Ethernet cross-over cable should be used. If the Power Module is going

to connect to a network switch before connecting to the user interface computer, a standard Ethernet patch cable may be used. It is not recommended that the Power Module share a network switch with other high-bandwidth network devices. See section on Network Connections for more information.

Connection Type	On Power Module	Mating Connectors
Power	IEC-320-C14 inlet socket	IEC-320-C13 connector plug
Transducer Module	BNC, RJ-45, terminal blocks for stranded wire	BNC, RJ-45, discrete wires
Network	RJ-45 socket	RJ-45 plug

Table 3. External Connections to Power Module

Indicator Lights

There are seven indicator LED's on the front of the Power Module casing. From left to right they are: TX Off, Fault, Ctrl A, Ctrl B, Ping, Bank 1, Bank 2. (Older versions of the Power Module may not include the TX Off or Fault indicators.)

1. TX Off - Indicates that the power amplifier is deactivated. This can be set by the slider switch on the front panel (rack mount version) or internally (bulkhead mount version) and used for testing the unit while in dry-dock.

2. FAULT - Indicates that a transmit signal triggering error occurred. Triggering errors are generally introduced by electrical interference along the cable. Such errors are generally handled by the Power Module and do not indicate a problem. This LED is used for troubleshooting purposes.

3. CTRL A, CTRL B - Indicates internal Power Module logic states. These are used for debugging purposes only and have no user application. The state of these LED's may change from time to time depending upon the particular mode setting of the sonar system. Once the Transducer Module has booted, these indicators will blink until the user interface communicates with the Transducer Module.

4. PING - Flashes every time the sonar transmits a ping.

5. BANK 1, BANK 2 - Indicates power amplifier capacitor banks are changed. These indicators may remain lighted for a short period of time after the unit is powered down.

Installation

The Power Module can be installed in any dry location within 100 feet of the Transducer Module. There are no user interface components on the Power Module other than a power switch. This means that even though it has blinking lights, it does not need to be located in a convenient to access location.

Warning

Make sure the Power Module is switched off before connecting to the Transducer Module.

Warning

The Power Module is not water tight and should not be located in an area with condensation.

1.4. Network Connections

FarSounder's sonar systems operate on a standard Ethernet network using TCP/IP protocol layers. Due to the high bandwidth needs of the FarSounder systems, the network must be capable of 1 Gbps connectivity.

It is also strongly recommended that the Ethernet network be private. For best performance results, the network should not be shared with other non-FarSounder network traffic. A private network can be established by keeping the network used to connect the user interface computers to the Power Module physically separate from any other Ethernet networks on the vessel. If the Power Module and user interface computer are connected to a network that has other devices connected to it, high network traffic generated by these other devices may reduce the update rate of the FarSounder sonar.

All sonar data from the Transducer Module is transmitted to the SonaSoft™ user interface via the Power Module. The Power Module connects to the network via a standard Ethernet cable and RJ-45 plug. All Ethernet cables should be capable of 1 Gbps data rates. Cat-5e is the minimum Ethernet cable requirement. Ruggedized Cat-6 or better is recommended.

When connecting to a single user interface, the Power Module can be connected directly to the user interface's network adapter using a standard Ethernet crossover cable. When connecting the sonar to multiple user interfaces, the Power Module should be connected a network switch. Each of the user interfaces then connect to the network switch with a standard Ethernet patch cable. The switch should be 1 Gbps capable.

Note

FarSounder recommends unmanaged switches as incorrect configuration of managed switches may cause performance issues.

Network Configuration

By default, FarSounder's current products are configured to operate on the 192.168.0.xxx subnet. Each Transducer Module is built upon multiple sonar data acquisition boards. Each board uses its own IP address on the network. An additional IP address is used for system maintenance. An internal gigabit network switch bundles the data from all cards into a single Ethernet connection accessed via the sonar's connection cable. FarSounder's legacy products operate on the 192.168.95.x subnet. IP addresses for FarSounder's products are shown in table 4.

Product	IP Addresses
FarSounder-500	192.168.0.2 192.168.0.3 192.168.0.254
FarSounder-1000	192.168.0.2 192.168.0.3 192.168.0.4 192.168.0.5 192.168.0.254
Legacy Sonars: FS-3DT	192.168.95.6

Table 4. Transducer Module IP Addresses

For installations with bow and stern navigation sonars, the IP addresses of the stern node are offset by 12.

Product	IP Addresses
FarSounder-500 (Bow Installation)	192.168.0.2 192.168.0.3 192.168.0.254
FarSounder-1000 (Bow Installation)	192.168.0.2 192.168.0.3 192.168.0.4 192.168.0.5 192.168.0.254
FarSounder-500 (Stern Installation)	192.168.0.14 192.168.0.15 192.168.0.254
FarSounder-1000 (Stern Installation)	192.168.0.14 192.168.0.15 192.168.0.16 192.168.0.17 192.168.0.254

Table 5. Transducer Module IP Addresses for Dual Sonar Installations

During the software installation process, the user will be prompted to let the software automatically configure the host computer's network settings. If this option is selected, the user will be prompted simply for a network address number. This is the last set of numbers in the IP address (i.e. 192.168.0.xxx). Each computer should have a unique network address number.

All computers running SonaSoft™ should be configured with the following network values:

- Subnet Mask: 255.255.255.0

- IP Address: 192.168.0.xxx (where xxx is an unused, unreserved IP. DHCP services may be used)[1]

- Gateway: not needed for FarSounder operation

- DNS: not needed for FarSounder operation

1.5. SonaSoft™ Software

SonaSoft™ is FarSounder's processing and display software. This software communicates directly with the sonar hardware, receiving all the raw data from the Transducer Module. All the processing takes place inside the SonaSoft™ computer.

Base Software Installation

In order to use the SonaSoft™ software, a system-specific installer is needed. This contains factory calibration information specific to the Transducer and Power Modules.

The sonar's software is pre-installed on computers purchased from FarSounder. The installer software can also be downloaded from FarSounder directly. Contact service@farsounder.com with the vessel's name and/or Transducer Module serial number to receive a download link.

The software installation process is simple. The installer program guides the user through each step. The installer also has options to configure the host computer's network settings and install the C-MAP USB dongle drivers, chart database and chart license. SonaSoft™ may be installed on more than one computer. However, the sonar systems are designed to allow one connection to the hardware at a time.

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[1]Computers connecting to legacy sonars must have an IP address on the 192.168.95.x subnet.

> ## Note
>
> It is recommended that the host computer be dedicated to SonaSoft™. Running other software packages on the same computer may significantly reduce the system's update rate.

C-MAP Chart License and Data Installation

FarSounder's display software includes chart overlay capabilities using C-MAP Professional+, ENC data from C-MAP, or S-57/63 charts. The chart data, however, must be licensed separately. In order to use the C-MAP or S-57/63 charts, the SonaSoft™ computer must also have a C-MAP eToken USB dongle (and its required drivers) installed. Each C-MAP license is tied to a particular eToken USB dongle.

During the software installation process, the user is offered the option to run the "C-MAP Setup Wizard". This includes installation of the eToken drivers, chart database and chart data license. This process is handled by the C-MAP Chart Manager utility provided by C-MAP and included in the SonaSoft™ installer. For future chart maintenance after SonaSoft™ installation, the C-MAP Chart Manager can be run from the Window's Start Menu or launched directly from SonaSoft™.

If the C-MAP eToken drivers are not installed, SonaSoft™ will not load the chart display at run time.

Initial Launch

When the C-MAP Chart Manager is initially launched, the user will be presented with the databases display panel as shown in Figure 21. Any databases that are already registered on the computer will be listed in this panel.
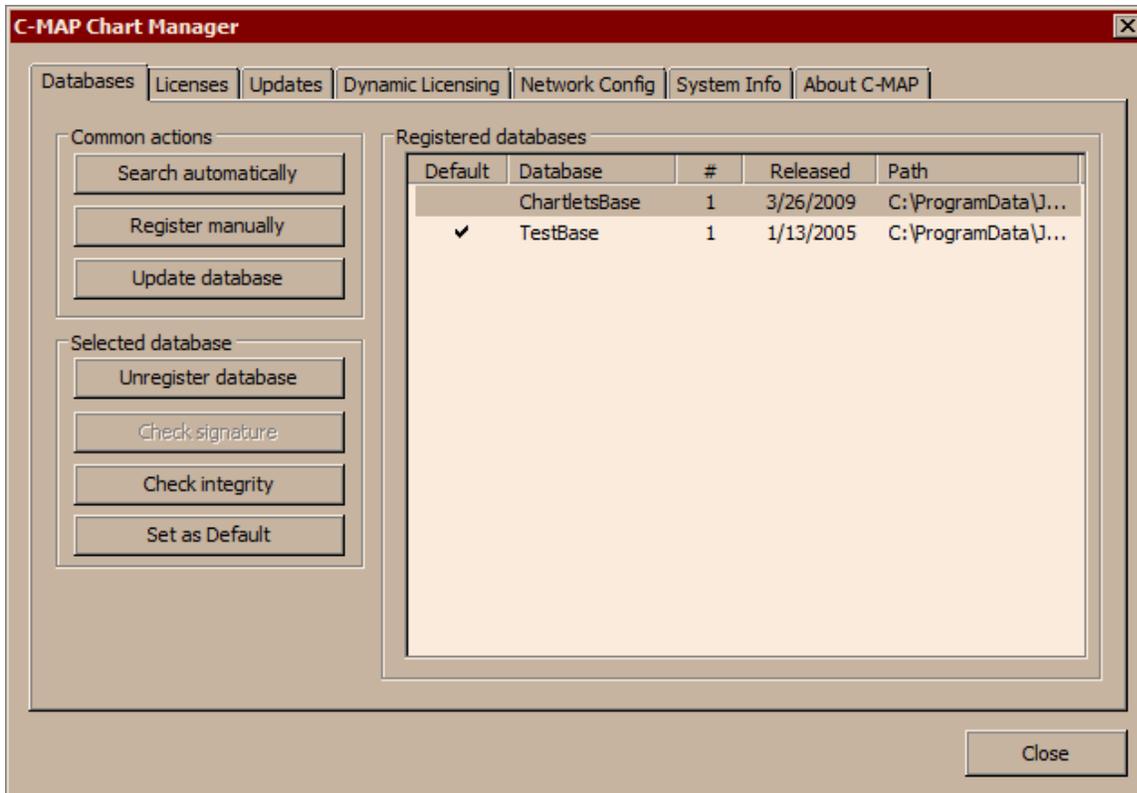
Figure 21. C-MAP "Databases" display panel

Registering a New Database

To register a database, first make sure that you have the latest chart data available on your machine. FarSounder provides C-MAP databases upon request, however we strongly recommend contacting C-MAP directly for their most up-to-date releases.

Once you have the most recent C-MAP chart data, place it in a local folder on your machine (we recommend `C:\cmap_databases`). Then, click the "Register manually" button in the C-MAP Chart Manger window. (Figure 22).
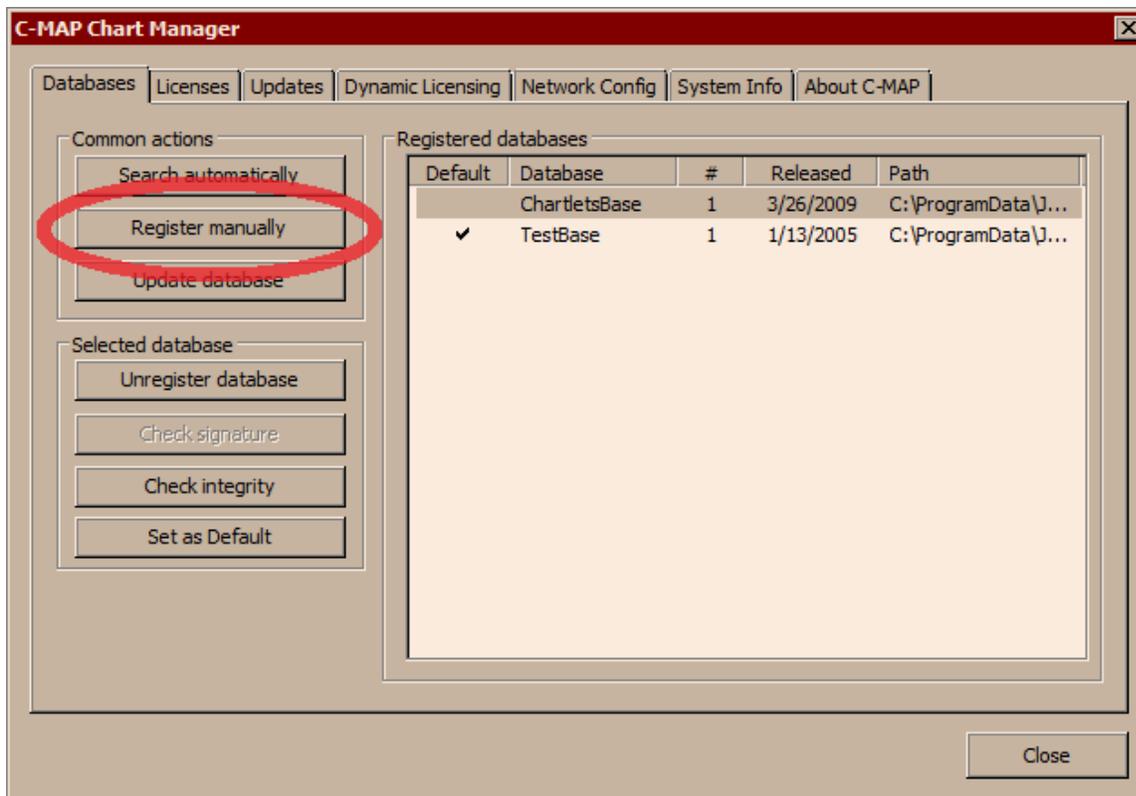
Figure 22. Click the "Register manually" button to browse for your database folder

Next, browse to the folder where you saved your database and click "OK". If done correctly, the Chart Manager should tell you that the database registration was successful, and you should be able to see the newly registered database in the "Registered databases" list as shown in Figure 23.
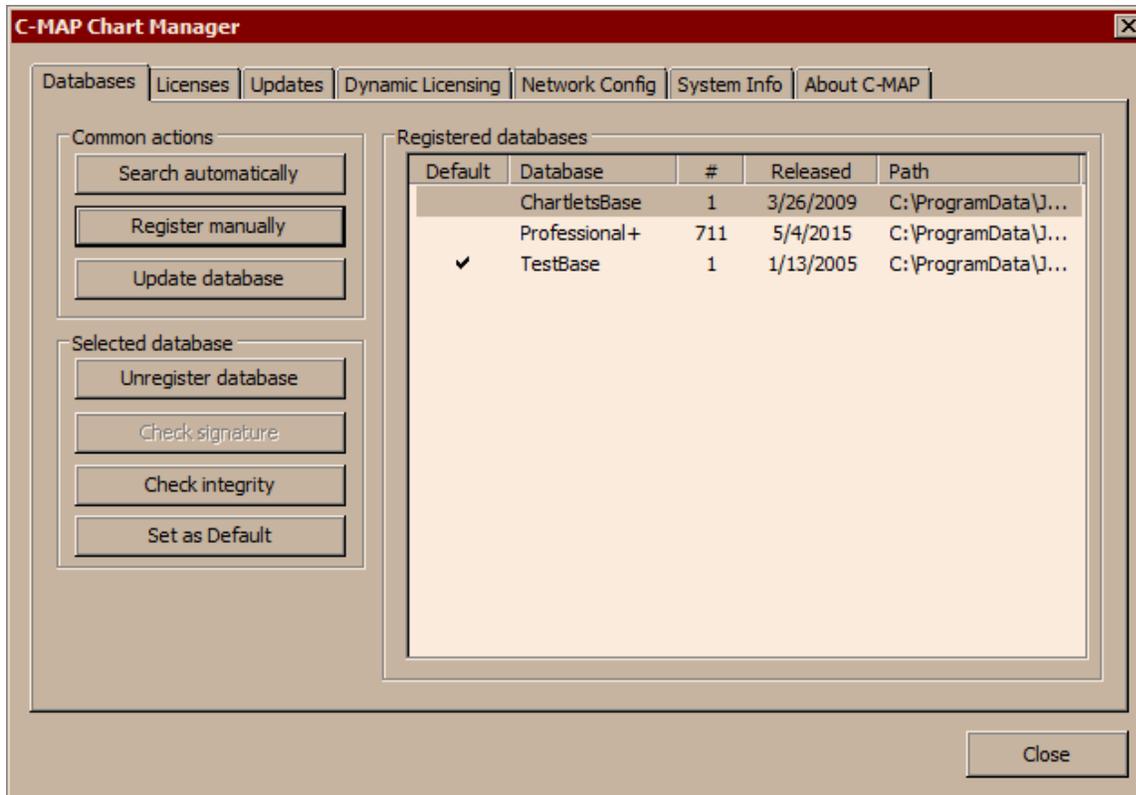
Figure 23. Newly registered database listed in the "Databases" panel

Highlight the newly registered database by clicking on it in the list and then click on the "Set as Default" button. This will load the database automatically each time SonaSoft™ starts.

Acquiring a License

Acquiring a C-MAP Database License

C-MAP chart data is organized by Zone and Area. Separate licenses are required for each Zone/Area. A license number can be obtained from C-MAP or a C-MAP distributor. Each license number is generated for a specific database and C-MAP eToken. If you already have a C-MAP eToken dongle, the dongle ID number must be provided to C-MAP. If not, dongles can be purchased from FarSounder or directly from C-MAP.

Enabling S-57/63 Support

An S-57/63 support license is needed to enable use of these charts within SonaSoft™. This license can be purchased from FarSounder. After applying the S-57/63 support license, S-57/63 charts can be imported via the 'ENCImporter' tool.

Applying a C-MAP Database License

After registering a database, it is time to apply a license to it so that the data can be decrypted. Start by clicking on the "Licenses" tab at the top of the panel. The "Licenses" panel will now be displayed as in Figure 24.
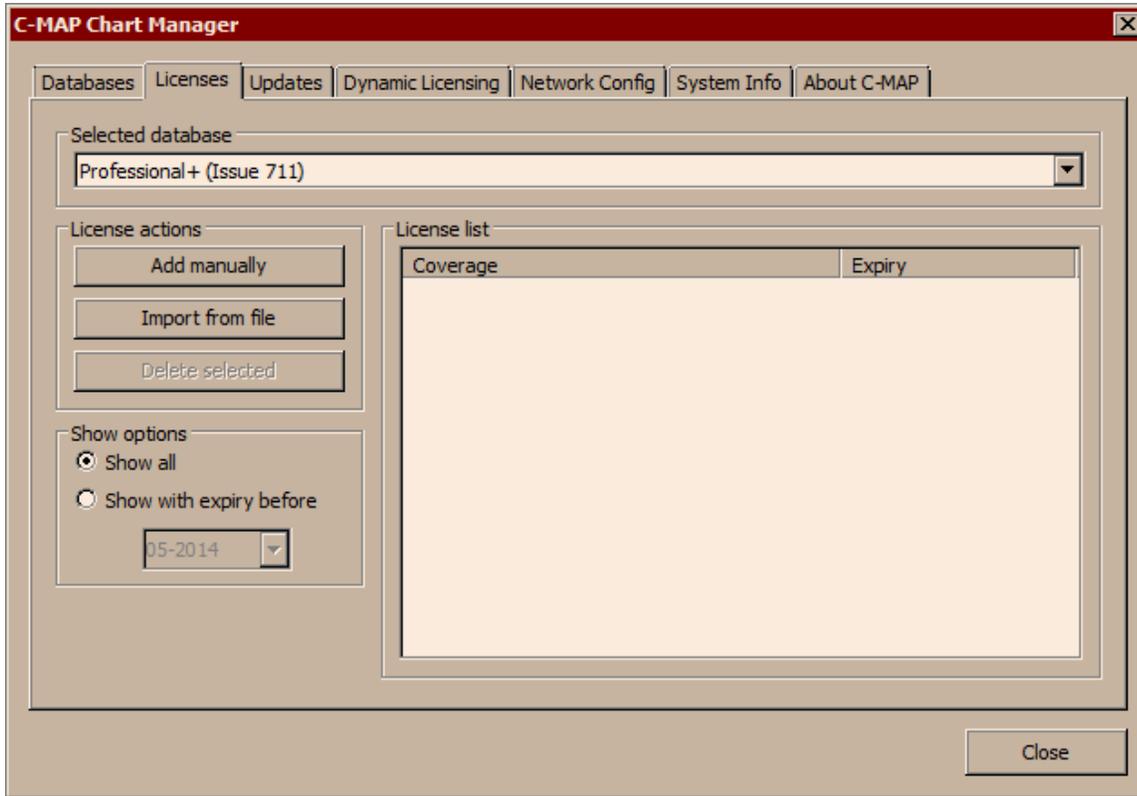
Figure 24. The "Licenses" display panel

Make sure that the newly registered database is shown in the "Selected database" drop down box. Then click on the "Add manually" button. This will display the "Add License Manually" dialog box as shown in Figure 25.
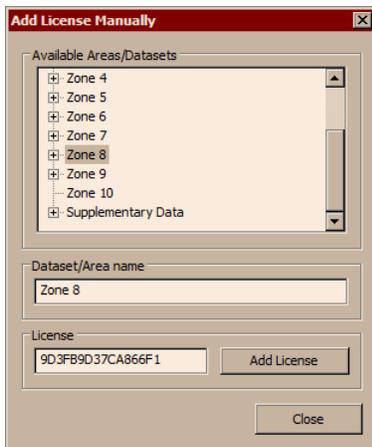
Figure 25. The "Add License Manually" dialog box

It is necessary to apply each license separately. To apply a license for a particular Zone or Area, select the Zone or Area from the "Available Areas/Datasets" list. Then copy the license number into the "License" field and click the "Add License" button. Repeat this process for each Zone or Area that has been licensed.

Once the license is applied, click the "Close" button to exit the dialog box. Then close the "C-MAP Chart Manager" by, again, clicking on the "Close" button in that window.

Applying an S-57/63 Support License

After purchasing the license it must be applied so that the 'ENCImporter' can be used to import S-57/63 charts. Open the 'Chart Manger' and go to the "Licenses" tab at the top of the panel shown in Figure 24. Use the "Selected database" dropdown to choose "Software Modules" and click "Add manually".
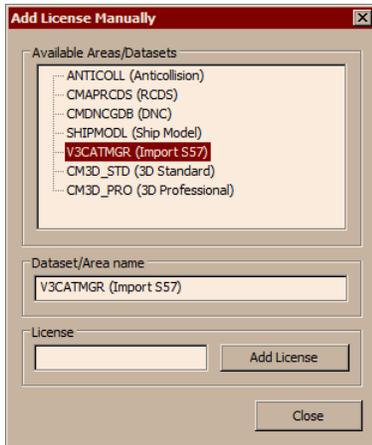
Figure 26. The "Add License Manually" dialog box

From this window choose "V3CATMGR (Import S57)" from the list of modules. Then copy the license number into the "License" field and click the "Add License" button.

ENCImporter

The ENCImporter imports S-57/63 charts for use within SonaSoft™.
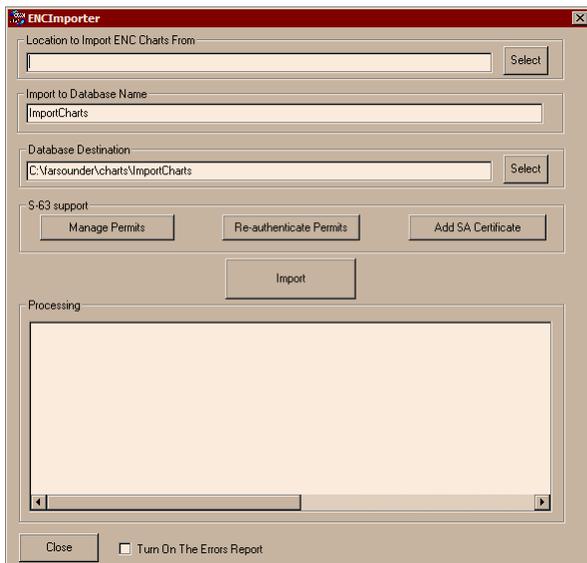
Figure 27. ENCImporter

The steps to using S-57 charts are as follows:

- First, locate the "ENCImporter.exe" in the "C:/Program Files (x86)/FarSounder/SonaSoft*/bin/" directory. Right click and select "Run as Administrator".

- Specify the location of the charts by selecting the location of the ENC_ROOT folder. This will be the folder which has all of the charts.

- Specify a name to use for the database in the "Import to Database Name" text box. This will be the name of the resulting C-MAP database.

- Choose a destination folder for the converted charts to be stored in.

Using S-63 charts require a few extra steps in addition to the ones above.

- The charts must be encrypted using a unique UserPermit which is obtained from FarSounder. This UserPermit must be provided to your chart providers and is used by them for encryption purposes.

- Next, add the permits. To do so use the "Manage Permits" button which will launch the "Manage Permits" dialog.
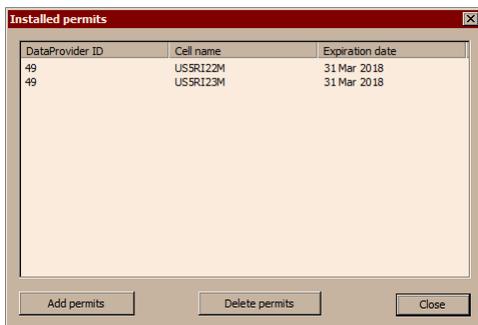
Figure 28. Manage Permits

- Listed here will be the information about previously added permits, as well as the option to add/delete permits. Select "Add permits" and add the corresponding permits for the S-63 charts.

- Click "Re-authenticate Permits" to verify the applied permits are valid for the imported charts

- If this is the first time using this application a SA Certificate must be added. Click the "Add SA Certificate" button.
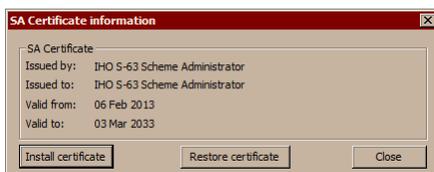
Figure 29. Add the SA Certificate

- Click "Install Certificate" and locate the SA Certificate. This file should come with the charts and should be called "IHO.crt"

- Lastly, click the "Import" button to import the charts. This can take a couple of minutes to a couple hours depending on how many charts are being converted. Once this is finished the charts will be able to be used just like any other C-MAP database. This database will show up in the "Chart Manager" shown in Figure 21.

Bridge Integration

There are three primary methods of integrating FarSounder sonars into a vessel's bridge: video matrix, thin client and ECDIS/ECS.

Method 1: Video Matrix

The simplest integration method is to connect the SonaSoft™ computer's video output and mouse/trackball input to a KVM or video matrix switch. This allows the computer's display to be shown on one or more bridge monitors. It can also enable one or more mouse/trackballs to control the computer. Since this method uses only a single computer, the same image is simply replicated on all displays. This type of integration is common on many yachts and commercial vessels.

Method 2: Thin Clients

The SonaSoft™ software can be configured as a network sonar server. In this mode, the software still performs all of the processing and produces a user interface display. However, it also allows for the connection of up to 4 additional thin client displays and the processed sonar data is shared amongst them. In this configuration, FarSounder's thin client software can be installed on multiple bridge stations. The display and control of each thin client operates independent of one another. All processor settings are shared across the network and the sonar can be controlled from the server or any client. Contact FarSounder for thin client details and pricing.

Method 3: ECDIC/ECS

A number of 3rd party ECDIS/ECS manufacturers have implemented their own FarSounder client capabilities as part of their ECDIS/ECS software. Just as they offer radar overlay, they also offer FarSounder sonar overlay. In this mode, SonaSoft™ is also configured as a network sonar server. It still performs all of the sonar processing and can still be used as a stand alone sonar display. Up to 4 clients can connect to the server simultaneously. FarSounder's server software distributes the processed sonar data over Ethernet using FarSounder's SDK interface.

1.6. External Sensor Connections

The SonaSoft™ user interface software has been designed to interface with external navigation sensors. Information from the vessel's GPS, heading sensor and echo sounder is used in various parts of the SonaSoft™ sonar processing and display.

The software interfaces to the vessel's navigation sensors via standard NMEA-0183 sentences. SonaSoft™ connects to these NMEA sensors via the host computer's COM ports. SonaSoft™ can listen to and process the following sentences: DBT, DPT, GGA, GLL, HDG, HDT, RMC, ROT, VHW, and VTG. For optimal performance, all messages should be produced at 1Hz output rates or faster. ROT should be produced at a 10 Hz output rate or faster. More information about the navigation data represented by each NMEA message type can be found in Section 7.2, "Configuration Manager Options".

It should be noted that one NMEA message type representing each of the following is required:

- True Heading (gyro or gps compass)

- Rate of Turn (gyro or gps compass)

- Position (gps)

- Speed Over Ground (gps)

- Course (gps)

If the vessel is equipped with an echo sounder it is recommended, but not required, for SonaSoft™ to listen for and display depth below vessel data as well.

In most cases, the host computer's COM ports will be basic serial ports (RS-232). However, some marine computers come equipped with true NMEA-0183 hardware ports (opto-isolated RS-422). In all cases, these COM port settings can be configured under the SonaSoft™ Configuration Manager by selecting the COM Port NMEA tab. If the host computer has multiple COM ports, the software can be configured to listen on multiple ports to multiple sensors. Additionally, a standard NMEA multiplexer can be used to connect multiple sensors to a single COM port. Computers supplied by FarSounder come with two RS-232 ports standard. Additional ports can be added via PCIe adapter cards or USB-to-RS232 connectors.

Additionally, most vessels will have traditional echo sounders operating in conjunction with the FarSounder system. In order to avoid interference with one another, it is recommended that the echo sounders be located as far from the FarSounder sonar as possible. To ensure that there is no interference (particularly if the echo sounders must be located near the FarSounder system) 200 kHz echo sounders should be used. These are almost guaranteed to never interfere with the FarSounder sonars. 50 kHz echo sounders are not recommended to be used in close proximity to the FarSounder Transducer Module since they are close to FarSounder's operating frequency of ~61 kHz and may interfere.

1.7. Operating the Sonar

Warning

Do not dry dock, haul, or otherwise remove the installed sonar from water without turning off the Power Module. The occasional surfacing of the Transducer Module in rough sea states will not damage the system.

In order to run the sonar, the Power Module and Transducer Module must be connected and turned on, the Power Module must be on the same network as the SonaSoft™ host computer, and SonaSoft must be running. After connecting the Power Module and Transducer Module together, both pieces of the hardware are powered on by turning on the power switch on the back of the Power Module.

There is no separate switch for the Transducer Module.

Once the hardware is turned on, the Bank 1 and Bank 2 LEDs on the Power Module should light, the Ping LED may flash once, and the Ctrl A and Ctrl B LEDs may or may not light. It takes about 90 seconds for the Transducer Module to start up, before which time, the SonaSoft program will start, but no sonar information will be visible.

If the TX Off LED is illuminated, no signal will be transmitted. This mode is intended for use in testing the system while the Transducer Module is not in water. However, it should only be used for limited duration testing. The slider switch on the front panel of the Power Module controls this feature.

The two Ctrl LEDs indicate internal Power Module logic states. These are used for FarSounder testing purposes only, and have no user application. The state of these LED's may change from time to time depending upon the particular mode setting of the sonar system.

After cold booting, the Ctrl A and Ctrl B LEDs will blink alternating AA-BB-AA-BB indicating the hardware is in standby mode waiting for a SonaSoft™ connection and able to accept firmware updates. The first connection after a cold boot may take up to 1 minute. Subsequent connections will only take a few seconds. After the first SonaSoft™ connection post cold boot, any time there is no SonaSoft™ connection, the Ctrl LEDs will blink A-B-A-B indicating the hardware is in standby mode ready to accept SonaSoft™ connections but cannot accept firmware updates.

2. SonaSoft™ User Interface Computer Requirements

2.1. Overview

The SonaSoft™ software package has significant hardware resource requirements. Performance may be affected if SonaSoft™ is run on a platform that does not meet these requirements. It is recommended that no other software applications are run during SonaSoft™ operation. As with any shipboard electronic systems, it is highly recommended that both the user interface computer and the FarSounder Power Module be powered through a UPS.

2.2. Minimum Requirements for FS-3DT, FarSounder-500, and FarSounder-1000 systems

- CPU: Intel i7 (six core)

- RAM: 6 GB minimum

- Video Card: nVidia GTX 660 with 2GB RAM

- Video Card Resolution: 1280 x 1024 minimum

- NIC: 1 Gb/s minimum (2 ports recommended)

- Operating System: Microsoft Windows Windows 7 Pro 64 bit (US Version)

- Serial: RS-232 or NMEA interface port

- Optical Drive: DVD-ROM (set up only)

- Keyboard: yes (set up only)

- Mouse/Trackball/HID: yes

3. The User Interface Workspace

3.1. Overview
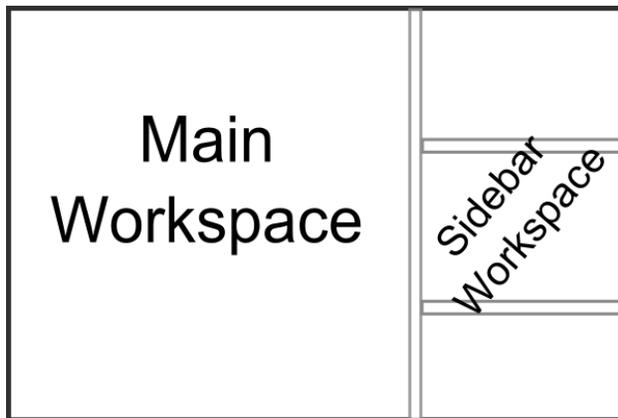
Figure 30. The user interface workspace

The SonaSoft™ user interface is divided vertically into two main sections called workspaces. On the left there is the "main workspace", and on the right there is the "sidebar workspace". These workspaces contain display windows for the different types of information displayed by SonaSoft™. The user can move a view from one workspace to the other at any time. In the main workspace, only one view is visible at a time. In the sidebar workspace, several windows are visible at a time, but they are much smaller.

The user can interact with the workspace through the following actions:

- Managing the Sidebar Workspace

- Resizing the Sidebar

- Using the Application Buttons

3.2. Managing the Sidebar Workspace

Windows in the sidebar workspace have a vertical window resizer bar along their bottom edge. They also have a left arrow button which when pressed will cause the selected side bar window to swap places with the main workspace window. Some display windows include a menu bar at the top of the window. Both the left arrow button and the windows menu bars will only be displayed when the mouse is within a sidebar window's frame. This way more display real estate is used for displaying pertinent navigation information. Note that when moved to the main workspace, no arrow buttons are ever displayed and menu bars are always visible.

Dragging the Sidebar
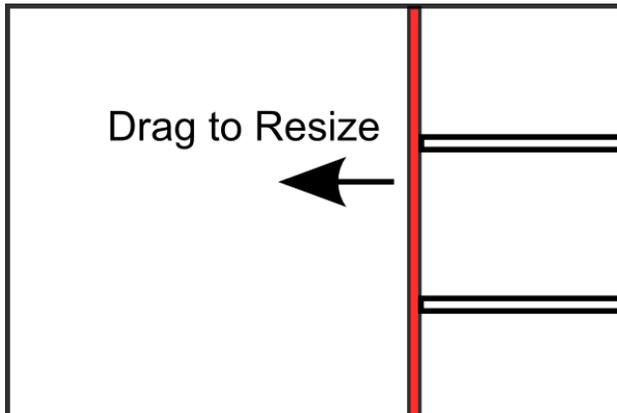
Figure 31. Left Click and Drag to resize the sidebar workspace

Between the two workspaces there is a vertical bar called the sidebar resize splitter. The user can drag the splitter with the mouse to resize the sidebar. To hide the sidebar (and all the windows it contains), drag the resize splitter to the right side of the screen. To quickly toggle between showing and hiding the sidebar workspace, double click on the resize splitter.

Resizing Sidebar Windows

The sidebar window views always take up the full width of the sidebar. As a result, the only way to resize the window is the sizer bar along the bottom border. To resize a sidebar window, click on the resizer bar and drag with the mouse while holding down the left mouse button.

Swapping Sidebar and Main Workspace Displays

The Swap-with-Main-Workspace Button moves a display from the sidebar workspace and places it in the main workspace. It is located on the dropdown toolbar. The view previously displayed in the main workspace is moved to the location sidebar where the new display in the main workspace was previously located.

3.3. Using The Application Buttons

At the very top left of SonaSoft™, are several buttons. These buttons are used to access menus and options for advanced controls and features.

Configuration Manager

The configuration manager button is shaped like a gear. Clicking this button displays the system menu. This menu provides access to:

- Configuration options for various components

- The System Status display

- The About panel

- Help documentation

- The exit button

Information about the particular configuration options available for each component is described in the individual component help descriptions.
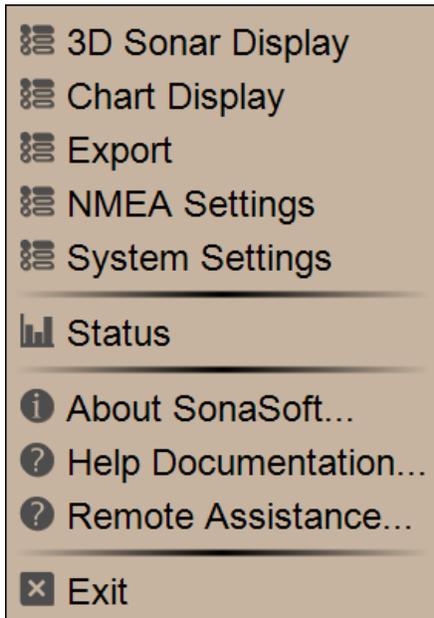
Figure 32. The System Menu

Color Themes

The color themes button is shaped like three vertical rectangles. Clicking this button opens a simple menu which lists the available color themes. Each theme is a set of colors that facilitates the use of the software in various lighting conditions. The software supports Day, Dusk, Night, and Red color themes. A theme may be selected by clicking on a theme from the list.

Sonar Status

The sonar status indicator looks like a series of sound waves moving horizontally through the water. The icon informs the user about the stength of the signal, and can be useful when in deep water to confirm that the sonar is operating even if no targets or seafloor are being detected.

The most likely cause of an off icon (and a non-functioning system) is having no network connection to the sonar. Otherwise, a dot with no bars indicates that there is little to no signal, one bar indicates a low strength signal, two a medium strength signal, and three bars a high strength signal.

3.4. System Status

The System Status display window displays real-time status information produced by various components of SonaSoft™. Some components include a status indicator icon. This icon is a circle colored either green, yellow, or red. Green indicates all systems are functioning properly. Yellow indicates there is a system warning. Red indicates there is a serious problem with part of the system.
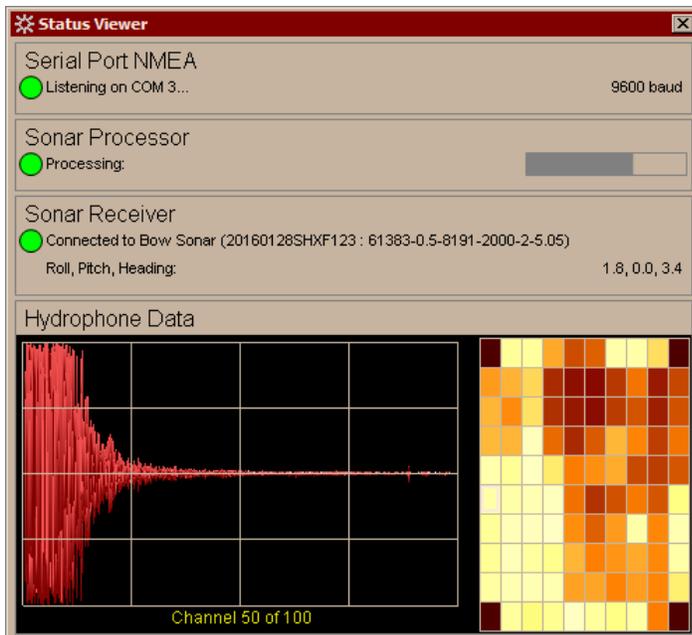
Figure 33. System Status display window

Figure 33, "System Status display window" shows the System Status display with three indicators and a hydrophone (receiver) waveform display.

The first indicator shows that the software is listening for NMEA messages over the serial port. The status of that component shows that it is listening on COM1 at 9600 baud. If more than one serial port is enabled, multiple ports would be listed here and the baud at which they are connected. These ports are configured under the Configuration Manager's NMEA Settings menu.

The second indicator shows that the Sonar Processor is properly configured and is in the middle of processing a ping.

The third indicator shows that SonaSoft™ is currently connected to the sonar and is awaiting data from the sensor. It also indicates the sonar's current roll, pitch, and heading orientation relative to the earth in degrees. This indicator may display a yellow or red status if there are problems connecting to the Transducer Module.

The Hydrophone Data display is somewhat different. It is a graphical display of hydrophone data. This display is very useful for debugging purposes and to confirm the presence of echo sounder interference. In this display, the waveform of a single receiver channel is shown on the left with the start of the echo's timeseries at the far left. On the right portion of this display is a graphic of the receiver's transducer array. Each box represents the spatial location of an individual hydrophone. Clicking on one of the boxes selects that channel for the waveform display. Note that the four corner channels are always blank.

3.5. Customizable Hotkey Support

All of SonaSoft™'s features can be controlled using a two button mouse/trackball. However, customizable hotkey support is also available for all user interface features, including the 3D Viewer Display, Alarm, Chart Viewer Display, Processor Settings, color scale settings, and theme.

Hotkey support makes integrating SonaSoft™ with physical controllers such as buttons, glass bridges, and custom foils easy. In fact, any controller that is capable of outputting standard keyboard commands can be used.

The default hotkey programming can be modified by editing the "hotkey.ini" file located in the "config" folder in the SonaSoft™ install directory, and restarting SonaSoft™. Formatting of each entry in "hotkey.ini" is as follows:

```
; Lines prepended with a ';' are ignored, and can be used for comments.
action = modifer keys
```

For example, the following syntax assigns the alarm toggle functionality to the key combination "Control +Alt+a".

```
; Toggle alarm on/off.
alarm = control alt a
```

Available 3D Viewer Actions

- alarm - toggle alarm on/off

- view - toggle 3D view between standard and 3D view

- color - toggle between depth and signal level colorscale

- panport - pan profile selector to port

- panstbd - pan profile selector to starboard

- rotateleft - rotate 3D view left

- rotateright - rotate 3D view right

- rotateup - rotate 3D view up

- rotatedown - rotate 3D view down

Available Chart Viewer Actions

- autocenter - toggle autocenter on/off

- zoomin - zoom in for chart viewer

- zoomout - zoom out for chart viewer

- erbl - toggle electronic range and bearing line on/off

Available Processor Settings Actions

- bottomdetection - toggle bottom detection on/off

- autosquelch - toggle autosquelch on/off

- increasesquelch - increase squelch

- decreasesquelch - decrease squelch

- cycleprocrange - cycle through processor ranges

- setprocrange1 - switch to shortest range

- setprocrange2 - switch to second shortest range

- setprocrange3 - switch to third shortest range

- setprocrange4 - switch to fourth shortest range (if available)

- setprocrange5 - switch to fifth shortest range (if available)

Available Global Actions

- depthscaleshallow - open the number pad to define the shallow end of the depth color scale

- depthscaledeep - open the number pad to define the deep end of the depth color scale

- highdbscale - open the number pad to define the high dB end of the signal level color scale

- lowdbscale - open the number pad to define the low dB end of the signal level color scale

- cycletheme - cycle through theme options

- setthemeday - switch to day theme

- setthemedusk - switch to dusk theme

- setthemenight - switch to night theme

- setthemered - switch to red theme

4. First Time Configuration

4.1. Overview

The first time the software is installed, there are a number of items which must be configured. These can always be changed later. However, not setting these items will affect the performance of the system.

4.2. Connecting NMEA Devices

Overview

The SonaSoft™ user interface software has been designed to interface with external navigation sensors via standard NMEA 0183 interface sentences. It is highly recommended that a GPS, echo sounder, and heading sensor (if available) be connected to the SonaSoft™ computer. Not including position, heading, depth, speed over ground, course over ground, and rate of turn information may significantly reduce the detection capabilities of the FarSounder system. Some of the other benefits of connecting external sensors include:

- plotting the ship's location and sonar data on top of a digital chart

- showing the Depth Profile angle in absolute heading

- displaying conning information

- in-water target and seafloor stabilization

- True Target Motion™

The SonaSoft™ software has been designed to accept information from external sensors via standard NMEA-0183 sentences. SonaSoft™ connects to these NMEA sensors via the host computer's COM ports. SonaSoft™ can listen to and process the following sentences: DBT, DPT, GGA, GLL, HDG, HDT, RMC, ROT, VHW, and VTG.

In most cases, the host computer's COM ports will be basic serial ports (RS-232). However, some marine computers come equipped with true NMEA-0183 hardware ports (opto-isolated RS-422). In all cases, these COM port settings can be configured under the Configuration Manager's COM Port NMEA tab. If the host computer has multiple COM ports, the software can be configured to listen on multiple ports to multiple sensors. Additionally, a standard NMEA multiplexer can be used to connect multiple sensors to a single COM port.

COM Port Configuration

All NMEA configuration options are accessed by selecting "NMEA Settings" from the Configuration Manager menu (see figure 34). This display includes a list of each available COM port. Each row in the list contains a check box, a COM port number, a baud rate selection drop down box, and a Show Trace button. SonaSoft™ can read all standard NMEA-0183 messages on any COM port in the list.
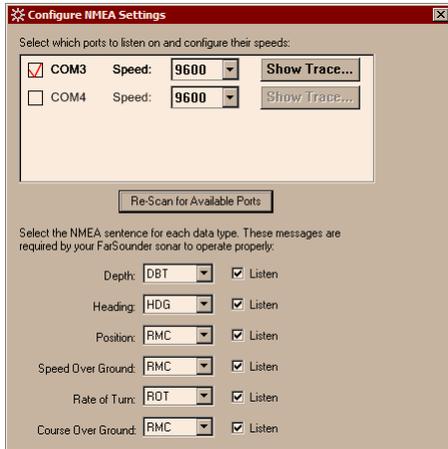
Figure 34. COM Port NMEA configuration options

COM Port Check Box

The check boxes indicate on which COM ports SonaSoft™ should listen (an empty box indicates that the port is not being used, a red check indicates that the port is in use). When the checkbox is checked, the show trace button will be active.

Baud Rate Drop Down Box

The baud rate for each COM port is selected with this drop down selection box.

Show Trace Button

Pressing the Show Trace button will pop up a window where the user can see all of the COM port data being read off the port.

Re-Scan for Available Ports Button

This button will re-scan to find any available COM ports for SonaSoft™ to listen on. Available COM ports will be listed in the COM port list.

NMEA Message Selection

At the bottom of this window, there are six rows of drop-down selectors where the NMEA messages to be used for Depth, Heading, Position, Speed Over Ground, Rate of Turn, and Course Over Ground can be selected. SonaSoft™ will only listen to the messages selected for each data type.

Each message type (Depth, Heading, Position, Speed Over Ground, Rate of Turn, and Course Over Ground) also has a "Listen" check box option. When "Listen" is unchecked, SonaSoft™ will not listen for any messages of that type. For example, if there are no Depth messages available on any of the COM ports selected, then the "Listen" checkbox for Depth messages can be unchecked.

Note

Message selection is independent of COM port selection. This means that if a particular message is selected for a given data type, it does not matter on which COM port it is received.

4.3. System Settings Options

Overview

There are a number of system settings inside SonaSoft™. These settings are general configuration options which are used throughout the software. These settings are found under the Configuration Manager's System Settings tab.
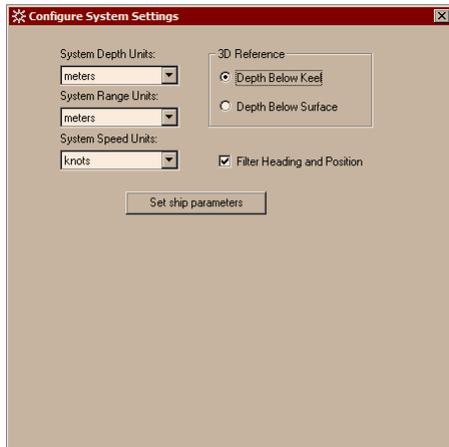
Figure 35. System Settings dialog box

System Depth Units

The units selected from this drop down box are used for depth measurements throughout various displays and setting controls within SonaSoft™. The following units are supported: feet, meters, fathoms.

System Range Units

The units selected from this drop down box are used for range measurements throughout various displays and setting controls within SonaSoft™. The following units are supported: feet, yards, meters, kilometers, miles (statute), miles (nautical), cables.

System Speed Units

The units selected from this drop down box are used for speed measurements throughout various displays and setting controls within SonaSoft™. The following units are supported: knots, meters per second, kilometers per hour, miles per hour (statute).

3D Reference

Using these radio buttons, the user can set the depth reference for the Chart Display and 3D Sonar Display to be relative to the vessel's keel or relative to the water's surface. Note that the depth displayed in the Nav Info Viewer's depth reference is set by the external NMEA sensor's settings.

Filter Heading and Position

By default, SonaSoft™ uses speed over ground, course over ground, and rate of turn information to filter heading and position data to higher levels of accuracy for its processing. Filtered data is also required to perform True Target Motion™ in the 3D Display. If the filtered heading and position of your vessel in your

chart overlay seem less correct than the raw NMEA values displayed in the conning view, please let us know so we can fix it. If that happens, unchecking this box will allow you to continue using SonaSoft™ with raw heading and position values until the time when we can resolve any issues you may have.

Ship Sensor Parameters

Vessel characteristics, such as length, beam and draft, along with GPS sensor and FarSounder™ sonar position should be specified using the Sensor Layout Configurator tool, which can be accessed using the "Set ship parameters" button in the "System settings dialog" (see Figure 35, "System Settings dialog box". An example of the Sensor Layout Configurator dialog is given by Figure 36, "Sensor Layout Configurator". Ship parameters can be entered into the Sensor Layout Configurator in either feet or meters. The preferred unit of measurement should be selected from the dropdown menu in the dialog. Then the remaining ship parameters, including the GPS sensor position and the FarSounder™Sonar position should be entered before clicking the update button.

Figure 36. Sensor Layout Configurator

4.4. Chart Setup

The SonaSoft™ Chart Display offers chart plotting capabilities with a real-time overlay of all in-water targets. The display supports Professional+ and ENC databases from C-MAP. This display capability is built into the base SonaSoft™ product. However, users must purchase a C-MAP eToken and chart license separately in order to load chart data.

Though the display is automatically part of SonaSoft™, chart databases and eToken drivers must be installed on each computer where chart data will be used. The easiest way to do this is to run the SonaSoft™ installer and select the "Run C-MAP Installer Wizard" when prompted. This wizard will install the eToken driver and launch the C-MAP Chart Manager. The C-MAP Chart Manager is used to load and register C-MAP chart data. Please follow the C-MAP Chart Manager documentation for assistance in running this tool.

Note

A keyboard is not needed when using the charts as part of the standard operation of the software. However, a keyboard is needed for chart installation and license registration. If no physical keyboard is available, the Windows on-screen keyboard can be used.

After the initial installation, the C-MAP Chart Manager tool can be launched directly from the Configuration Manager menu within SonaSoft™.

5. The 3D Sonar Display

5.1. Overview

The 3D Sonar Display is the window where FarSounder's 3D forward-looking sonar information is shown. In this view, the user is given a 3-dimensional picture of the seafloor ahead of the vessel along with in-water targets. FarSounder's processing algorithms use spatial classification techniques which are used to differentiate between the seafloor and in-water targets. The sea floor is displayed as a smooth continuous surface while in-water targets are displayed as small spheres, also known as voxels, which represent the target's 3D location.

All FarSounder sonars are specified as 8 water depth sonars. This means that they can map the seafloor out to a distance of at least 8 times the depth of water in which the sonar is operating. Beyond their water depth capabilities, the products can still detect in-water targets out to the full range of the system. See Appendix A, *Understanding Water Depth Performance* for more information.

All echoes classified as in-water targets are tracked from ping to ping by the signal processing algorithms in FarSounder's software. If a target is only detected on a single ping, it is hidden from display. This minimizes false alarms from reflections off of waves and other transient clutter. If a target is tracked across multiple pings but is not detected on a subsequent ping, the target is shown on the screen at the predicted location (based on previous target locations and vessel movements). See Appendix B, *Ping-to-Ping Target Stabilization* for more information.

The user can select between the 3D volumetric display, which allows the user to rotate the 3D image with real-time perspective, and the standard display, which shows the 3D information in a look-down display (much like a radar view, except below the water).

The Sonar View consists of three main components: the 3D volumetric/standard views, the profile view, and the menu bar. These are shown in the figure below. Additionally, the user can set an alarm, display 2D depth profiles ahead of the vessel at a user selected bearing, and configure other advanced options in the display. This display also has various settings available in the Configuration Manager.

5.2. 3D Volumetric/Standard View

This view shows the data in either 3D Volumetric or Standard modes. To switch between these modes, click the mode button in the menu bar.

In the 3D volumetric mode (see figure 37), the data is shown with shading and perspective. Color can be mapped to depth (where blue is deep and yellow is shallow) or signal level (where dark brown is quiet and light copper is loud) as defined in the color scale. Any mouse movement while clicking and holding the left mouse button will rotate the entire 3D volume of data.
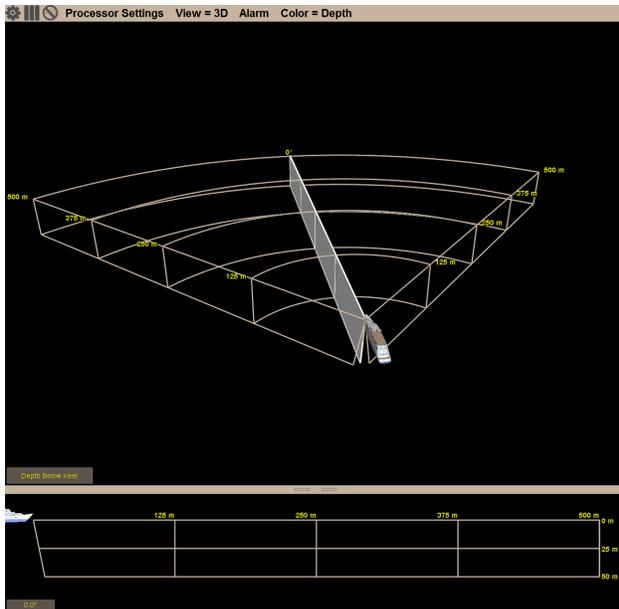
Figure 37. The 3D Sonar Display

In standard mode (see figure 38), the data is shown with perspective turned off (orthographic projection) with the user looking down on the data. This looks much like a common radar display. However, where radar gives a picture of what is above the water, FarSounder's sonar displays a picture of what is below the water. As with the 3D volumetric mode, the standard mode has the capability to map color to depth or signal level.
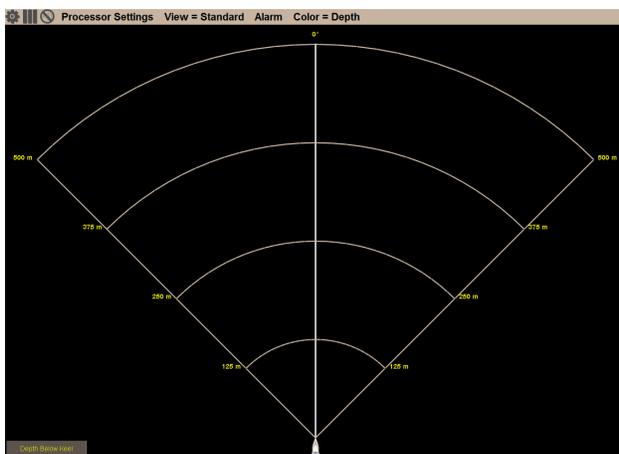
Figure 38. Standard Mode

In both modes, a white line (or plane) is shown. This is the Profile Selector. The Profile Selector denotes the angle along which a 2D depth profile ahead of the vessel is shown in the Profile View. The number at the end of the profile selector denotes the bearing of the profile selector relative to the vessel's bow or the actual compass heading. This option is configured in the 3D sonar view's configuration options. The depth profile slice specified with the Profile Selector is shown in the Profile View.

5.3. Profile View

The Profile View shows the depth profile (bathymetry) ahead of the vessel at the bearing selected by the Profile Selector in either the 3D Volumetric or Standard View. The bearing angle of the Profile Selector and the depth profile currently selected is shown in the lower left corner of the Profile View. In the Configuration

Manager options, the user can select between displaying the Profile Selector bearing relative to either the vessel or the absolute heading.

5.4. Forward Looking Alarm Use

The user can define an alarm which will automatically notify the user of potentially hazardous obstacles. The user can define the area of surveillance for the alarm by depth, minimum range, maximum range, and field-of-view angle width. The user is notified by both visual and audible notifications. Additionally, the user can specify the number of hits before the alarm is triggered.
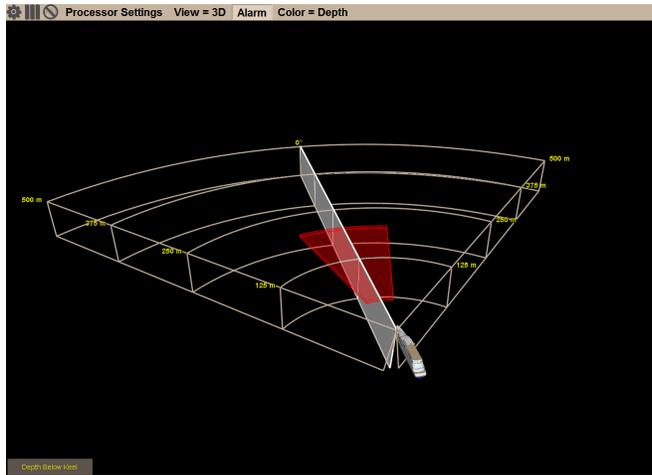
Figure 39. Alarm volume shown in red

Alarm Operation

Once configured, the alarm is simple to use. The alarm can be turned on by clicking the "Alarm" button in the Menu Bar at the top of the 3D Sonar Display window. Once active, the alarm conditions will take effect. The alarm will ONLY be triggered if the button is set to active. When active, the alarm button is depressed.

Figure 40. Alarm acknowledge button

Should the alarm be triggered, a warning will sound, the 3D Sonar Display window will blink blue, and an alarm acknowledge message box will appear in the lower left corner of the sonar viewer window. Simply click the "acknowledge alarm" message box to acknowledge and temporarily silence the alarm. For example, the vessel may be passing by a shallow area which triggers the alarm. After the user acknowledges the alarm, it will not sound again even if alarm conditions are met until the alarm acknowledge time of thirty seconds has passed. If alarm conditions still exist after the alarm acknowledge time has passed, the alarm will sound again.

Alarm Configuration

The user definable alarm is configured via the 3D Sonar Display's Configuration Manager menu. When configuring the alarm, the user can define the volume of water within which targets will trigger the alarm. The trigger area is defined to be the volume of water bounded by 4 thresholds: Field-of-View (FOV) angle, Max Range, Min Range and Max Depth.
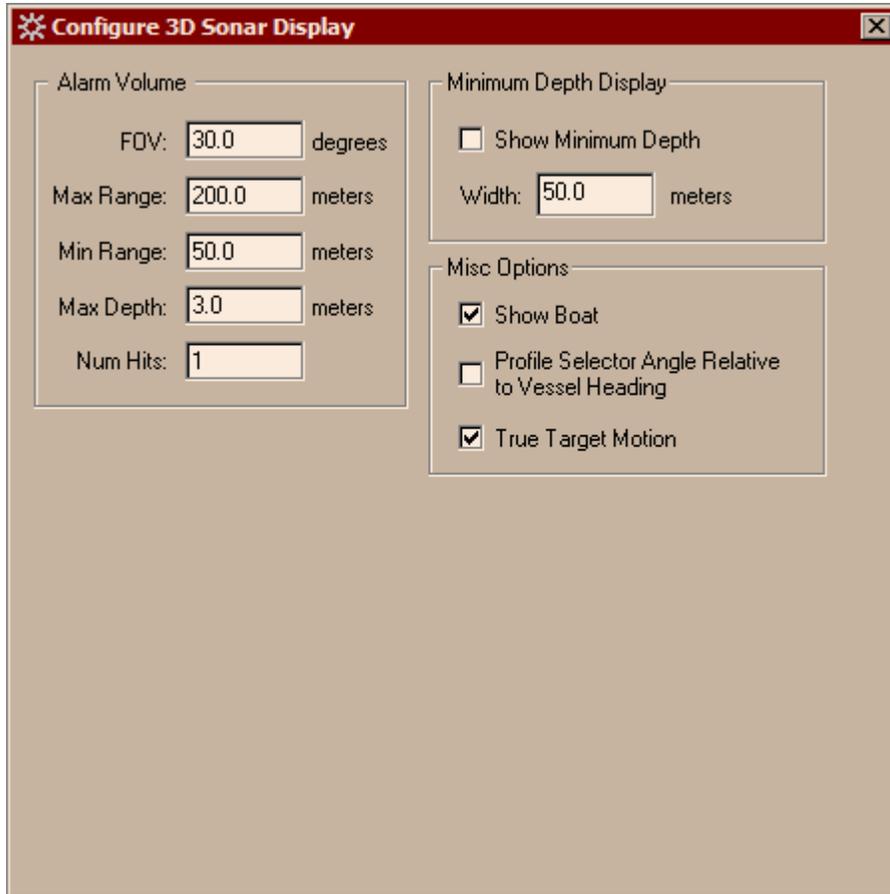
Figure 41. Alarm configuration settings

The FOV setting specifies the sector width of the alarm trigger volume in degrees. For example 60.0° means that only targets within 30.0° to either side of the bow will trigger the alarm. The Max Range setting specifies the maximum range extent of the alarm trigger volume. The Min Range setting specifies the minimum range extent of the alarm trigger volume. The Max Depth setting specifies the maximum depth of the alarm trigger volume. The Max Range, Min Range, and Max Depth settings are displayed using the unit of measure defined in the Configuration Manager's System Settings.

Like any marine sensor (radar, echo sounder, etc), the FarSounder sonar systems may detect spurious noises. These "noises" include reflections from bubbles in the water column and small bits of debris in the water. The alarm hit number specifies the number of pings in a row that a target must be detected within the alarm volume to trigger the alarm. By specifying a number higher than 1 for the hit number, false alarms can be reduced. For every ping with a detection within the alarm volume an internal counter is incremented. For every ping without a detection within the volume the internal counter is decremented until reaching a minimum value of 0. If the counter value reaches the hit number specified by the user, the alarm is triggered.

5.5. Additional Configuration Manager Options

In addition to the alarm settings, the 3D Sonar Display includes other Configuration Manager options.

Minimum Depth Display

When the Show Minimum Depth checkbox is set, the shallowest depth detected by the sonar ahead of the vessel within a designated route safety zone is displayed as a single number at the top left of the 3D Sonar

Display. The route safety zone extends directly ahead of the vessel out to the full range of the sonar and is indicated by a green "channel" displayed in the 3D Sonar Display. The width of the route safety zone is set by the user from the Configuration Manager's settings menu.
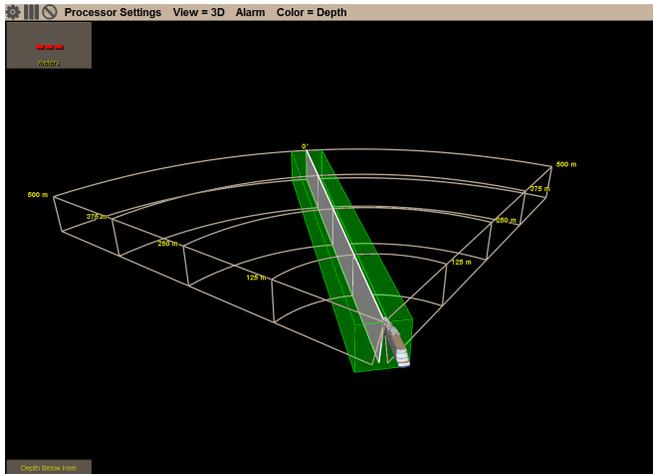
Figure 42. Minimum Depth Display's route safety zone shown in green

Show Boat

This checkbox toggles the display of the boat graphic inside the 3D Sonar Display.

Profile Selector Angle Relative to Vessel Heading

When selected, the profile selector's angle indicator in the 3D View will be relative to the vessel's heading. For example, if the vessel heading is 243° and the profile selector is angled 15° to starboard, then the profile selector's indicator will read 258°. When not selected, the indicator will be relative to the bow. In all cases, the indicator in the 2D View is relative to the bow.

True Target Motion™

With True Target Motion™ enabled, SonaSoft™ will use the NMEA data provided to it to update the 3D Sonar Display and the Chart Display in real time. For the 3D Sonar Display, this means that the seafloor and any in-water targets will move relative to to the displayed vessel and field of view's location. In the Chart Display, the vessel and the field of view will move relative to the chart and the overlayed seafloor and in-water target data.

> ### ℹ Note
>
> To use this feature, position, heading, speed over ground, and course over ground information must all be available to SonaSoft™ at at least 1 Hz, and rate of turn must be available at at least 10 Hz.

5.6. Menu Bar Controls

Processor Settings

Click this button to toggle display of the Processor Settings toolbar (see section entitled "3D Sonar Processing Options").

Standard/3D View

Click this button to toggle between standard view mode and 3D view mode. By default, both of these modes map the color of sonar targets to depth, where blue is deep and yellow is shallow. The user can define these values with the Color Bar. Additionally, for advanced applications, the color map can be changed so that color indicates the strength of the received signals from a particular target. In this mode, white copper is "loud" and dark brown is "quiet".

Activate Alarm

When depressed, the alarm is active, and will be triggered by objects in the alarm volume.

Depth/Signal Level Color Map

This button toggles between color mapped to signal level in decibels and color mapped to depth. Signal level is colored with a color map of varying copper hues. Dark brown indicates a quiet signal and a light, almost white copper indicates a loud signal based on the user's definition of "quiet" and "loud". All signal levels quieter than the "quiet" are dark brown and all signal levels louder than the "loud" setting are white copper. Signal levels in between are colored with a smooth array of hues between the dark and light copper colors.

Depth is colored with a multi-color map where blue indicates deep and yellow indicates shallow based on the user's definition of "shallow" and "deep". All depths deeper than the "deep" setting are blue and all depth shallower than the "shallow" setting are yellow. Depths in between are colored with a smoothly changing array of colors from blue to green to orange to yellow.

Note

Targets where depth cannot be accurately determined (i.e. beyond the sonar's water depth limit) are always drawn with the signal level color map. This is true even if the color map is set to depth. In this case, targets within the sonar's bottom mapping range and the sea floor will be displayed with their colors indicating depth (blue to yellow) while longer range targets will be displayed with their colors indicating signal level (dark brown to light copper).

When switching between color maps, the color scale will be changed to the user's last color extent values for the color map currently being shown. The user can change the scale's extents by clicking on the extent values. A number pad will then pop up allowing for mouse or keyboard specification of a new value. The new settings will be active on the next ping.

With color mapped to depth, the depth indicated is either "Depth Below Surface" or "Depth Below Keel" as noted by a label in the bottom left corner of the 3D sonar display. With color mapped to Signal Level, the numbers correspond to the same scale as the Squelch settings as described in "3D Sonar Processing Options".

5.7. Mouse Controls

Mouse Drag Left Button (Any Direction in 3D View)

Left dragging has two different behaviors, depending on where the user starts dragging the mouse.

When positioned at the end of the profile selector, a large double sided arrow will appear. In this case, left dragging will change the angle of the profile selector.

When in 3D mode and not over the end of the profile selector, left click dragging the mouse will rotate the 3D display volume.

5.8. 3D Sonar Processing Options

Like other marine electronics sensors, there are processing control settings for the FarSounder sonars. FarSounder has developed autonomous processing algorithms that intelligently control various stages of the processing routines and automatically remove most of the "noise" in the image without user interaction. The few controls that require user interaction are found in the Processor Settings tool bar (Figure 43, "Processor Configuration Window"). This tool bar is displayed when the user clicks on the "Processor Settings" button at the top of the 3D Sonar Display (see Figure 37, "The 3D Sonar Display"). Working from left to right, this window has the following controls: a processing mode drop-down selector, an "Auto Squelch" check box, a "Detect Bottom" check box, and a "Squelch" slider.

Note that when changing any of the processor settings (ie. squelch levels, processing ranges, etc.) changes will not take effect until the next complete processing cycle. This typically means that you will see the change two pings after adjusting the control, since generally when you see an image that needs adjusting, there is already another ping processing with those same settings internal to the software. Changes will be applied to the next "fresh" ping.

Figure 43. Processor Configuration Window

Processing Mode Drop Down Selector

The processing mode selection drop down sets the system's range and field of view while pinging.

- FarSounder-500 and FarSounder-1000 options:

  - 90° x 100m (325 ft)

  - 90° x 200m (650 ft)

  - 90° x 500m (1640 ft)

  - 60° x 1000m (3280 ft) *(FarSounder-1000 only)*

- FS-3DT options:

  - 90° x 110m (360 ft)

  - 90° x 220m (720 ft)

  - 90° x 330m (1080 ft)

  - 60° x 440m (1440 ft)

  - Alternating between 90° x 330m (1080 ft) and 60° x 440m (1440 ft)

Detect Bottom Check Box

The FarSounder system is typically capable of mapping the seafloor down to 50 meters depth (approximately 165 feet). In deeper water, the processing algorithms may falsely interpret in-water targets as the sea bottom and create some strange images.

If this check box is checked, then the processor will attempt to detect the bottom so that it may be drawn as a surface in the 3D Sonar Display. If this check box is not checked, then there will be no surface drawn in

the 3D Sonar View. *Note: If this check box is not checked and there is a sea bottom, then that bottom may show up as a large number of targets, provided the squelch is set to a low enough value.*

Squelch Control

Targets on the seafloor beyond the bottom mapping limit or in the water column are detected as in-water targets. In order to detect in-water targets, a detection threshold based on the signal level of the in-water targets must be specified. This threshold is call the In-Water Target Squelch level and it operates similar to the squelch level on a radio. With a high squelch level, small signals are rejected but little noise is accepted; with a low squelch level, small signals are accepted but more noise is detected too.

Auto Squelch Check Box

With Auto Squelch checked, the software automatically determines the best detection threshold using adaptive thresholding methods. Auto Squelch is the recommended operating mode for detection of in-water targets.

Squelch Control Slider

Most of the time, Auto Squelch mode will perform better than manually setting the squelch level. However, Auto Squelch may occasionally allow too much clutter to pass through the filters. In this case, the user can still increase the squelch level manually (though they can never reduce the squelch lower than the automatically detected level). The lowest signal level detected with Auto Squelch is indicated next to the manual squelch slider and can be used as a reference when switching to manual squelch mode.

Like with radar, it is recommended that the squelch be set so that occasional false alarms are detected. This will help to ensure that real targets are not missed due to squelch levels set too high.

When making squelch adjustments, typically a change of a few dB is all that is needed. Remember that changes generally take two pings to become visible.

6. Chart Display

6.1. Overview

The SonaSoft™ Chart Display offers chart plotting capabilities with a real-time overlay of the seafloor and all in-water targets. The Chart also displays all Local History Mapping™ (LHM) data. The display supports:

- Professional+ database from C-MAP

- ENC databases from C-MAP

- S-57/63 charts

The Chart Display window provides various chart plotting functionalities, such as showing the position of the vessel on the chart, zooming in and out on the chart, measuring the distance between two points on the chart, and showing latitude and longitude coordinates of the cursor position. Figure 44, "SonaSoft™ Chart Display" shows a sample screen shot. The various features and controls are explained in the following subsections.
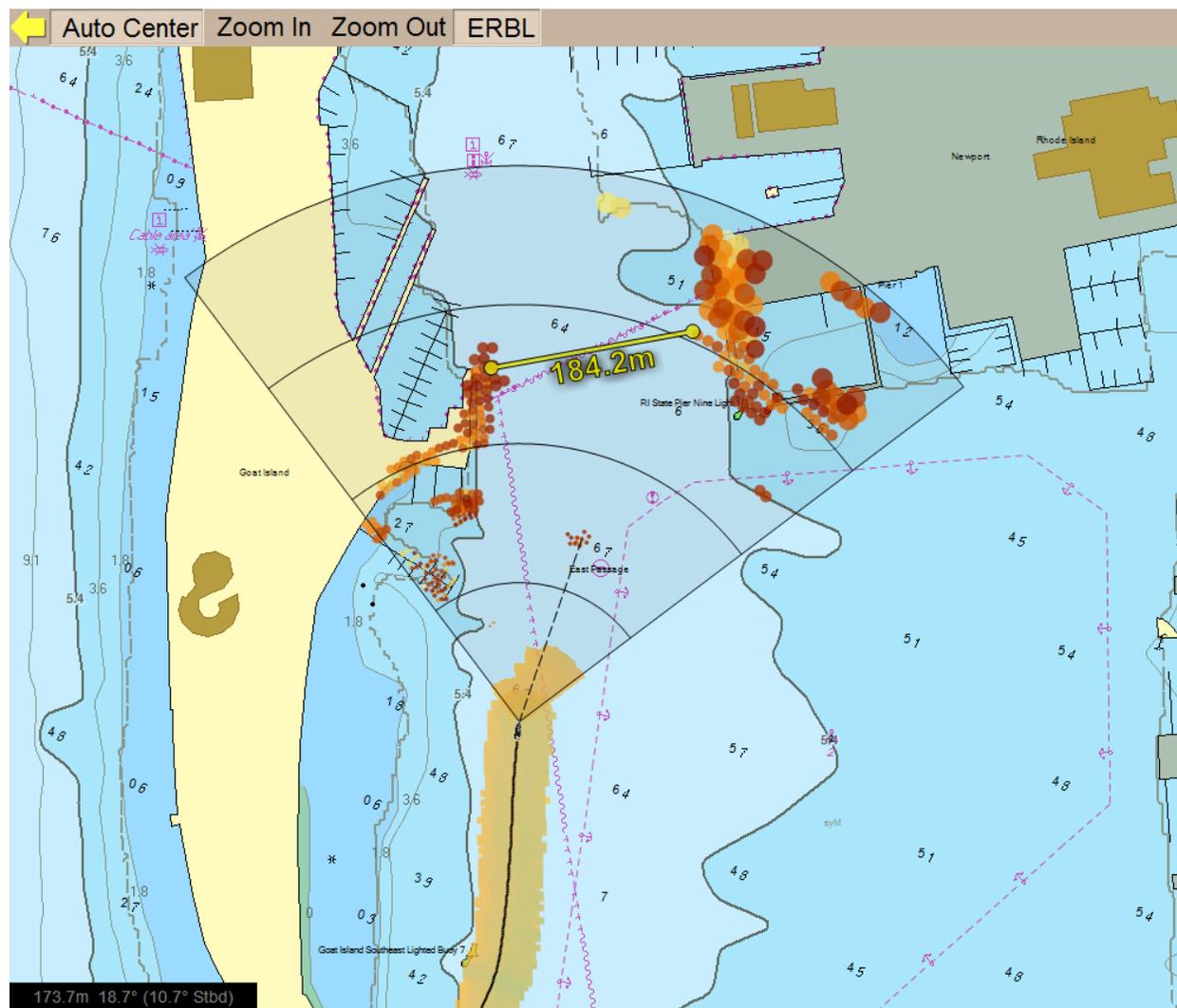
Figure 44. SonaSoft™ Chart Display

6.2. Chart Overlay Explained

Realtime Sonar Data

All 3D sonar data is displayed as an overlay on top of the nautical chart. This overlay capability increases user comprehension significantly as "stray" in-water targets often correspond to a feature included on the chart. Sometimes such features are not well located on the chart (such as markings indicating simply "rocks" or "reef"). The sonar is able to locate the actual positions of these features as indicated by the overlay.

In the overlay, the seafloor and in-water targets are drawn as a translucent surface on top of the chart. Color is mapped to the same color scale settings used in the 3D Sonar display.

Local History Mapping Data™ (LHM)

Seafloor data is persisted for the last hour of operation and displayed as an overlay on top of the nautical chart. The LHM display color is mapped to the same color settings used by the 3D viewer.

6.3. Menu Bar Controls

Auto Center

When depressed, the vessel graphic will remain in the window with any new GPS information updates received by the Digital Chart Viewer. Otherwise, the vessel will move across the chart with each latitude/ longitude position update.

Zoom In

Clicking this button will zoom in on the scale of the chart. If auto center is depressed, then the boat will be at the center of the newly zoomed view. If auto center is not checked, then the zooming will be centered on the center of the displayed chart.

Zoom Out

Clicking this button will zoom out on the scale of the chart. If auto center is depressed, then the boat will be at the center of the newly zoomed view. If auto center is not checked, then the zooming will be centered on the center of the displayed chart.

ERBL

Electronic Range and Bearing Line. When depressed, a line is drawn from the bow of the vessel to the cursor. The status window displays the distance between the bow and the cursor, as well as the relative bearing and absolute bearing.

6.4. Mouse Controls

Left Button Mouse Click

Clicking the left mouse button will pan the chart image by centering the chart on the mouse position.

Right Button Mouse Drag

Dragging the mouse with the right mouse button down will draw an orange range line from the initial mouse position when first depressed to the final mouse position when released. While the button is depressed, the

length of the line specified in system units will be drawn near the mouse. Once released, the distance will be displayed along the orange line.

Right Button Mouse Double Click

Double clicking with the right mouse button brings up a dialog that provides information about objects under the cursor.

Shift + Right Button Mouse Double Click

Double clicking with the right mouse button while holding shift brings up a dialog with detailed information about the databases and objects under the cursor. This dialog is for *experts only* while troubleshooting database issues.

6.5. Configuration Manager Options

In order for this component to work properly, NMEA compatible heading and location sensors must be connected to the SonaSoft™ User Interface computer. These sensors include: GPS, loran, compass, etc. More information on NMEA connections can be found in the chapter entitled Section 4.2, "Connecting NMEA Devices". Under the Configuration Manager's Chart Display tab, the user can specify the type of NMEA message to use. The user can select between RMC (recommended minimum specific GNSS data), GGA (global positioning system fix information), HDG (heading, deviation, and variation) and HDT (heading true) where appropriate.
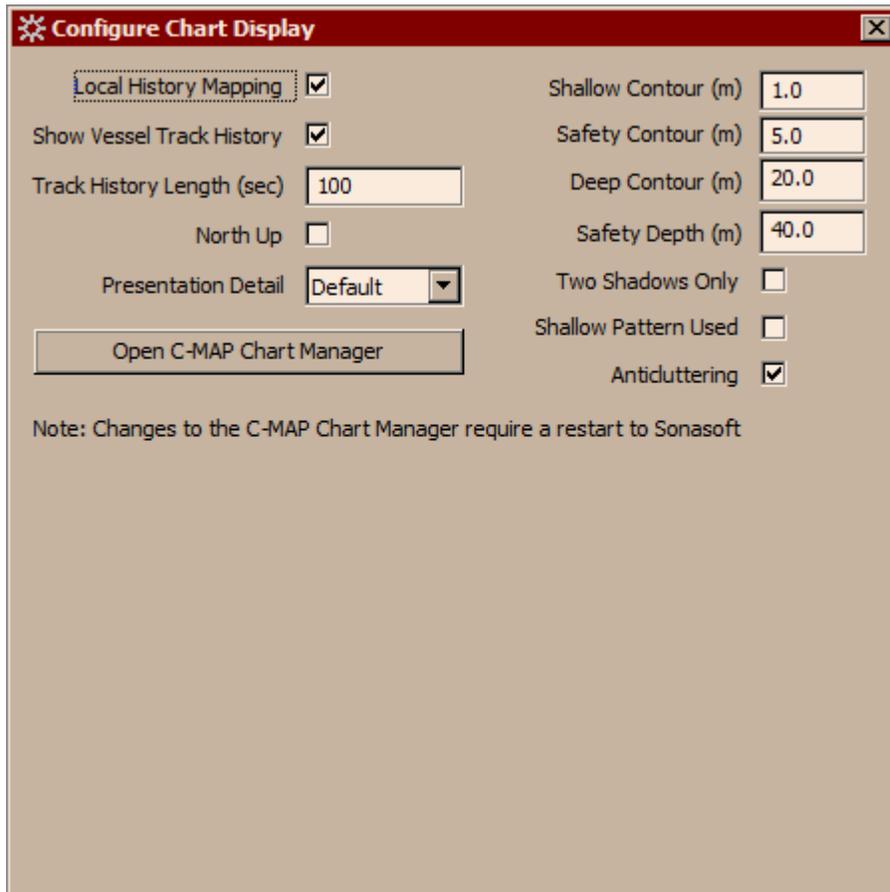
Figure 45. Chart Display Configuration Manager Options

Track History Length

Every time a new latitude and longitude position is received by the system, the vessel's position is updated on the chart, and a line is drawn between consecutive positions that are close together. The number of seconds of most recent locations noted is defined by the Track History Length setting. A setting of 0 removes all history markings from the chart.

North Up/Heading Up

If this option is selected, the chart will be oriented with North facing up. Otherwise, the chart will be oriented with heading facing up.

Presentation Detail

The Presentation Detail drop-down menu determines which presentation parameters are displayed as overlays on top of the chart. Successive levels of presentation increase the number of elements shown.

Open C-MAP Chart Manager

Opens the C-MAP chart manager to change the database in view.

C-MAP Chart Manager

Used to add or remove C-MAP chart databases on the system. To add a database to the system, use the "Search Automatically" button to locate and register the database. When prompted, save this database to the hard drive. The recommended location is `C:\cmap_databases`.

! Important

> Changes in this dialog require a restart to SonaSoft™.
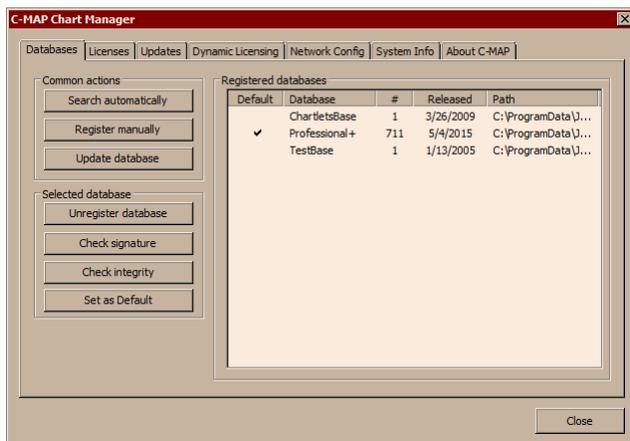
Figure 46. C-MAP Chart Manager Dialog

! Important

> For a database to be loaded automatically on SonaSoft™ startup, it must be set as the default in the Chart Manager.

If licenses have been purchased for this database, use the Licenses tab in the Chart Manager to unlock the purchased areas. Please refer to documentation from C-MAP for more information about using their licenses.

Note

A keyboard is not needed when using the charts as part of the standard operation of the software. However, a keyboard is needed for chart installation and license registration. If no physical keyboard is available, the Windows on-screen keyboard can be used.

Defining Chart Display Decoration Depths

The chart display can be further customized based on various depth definitions set by the user. These decorations include different coloring schemes between Shallow, Safety and Deep Contours as well as the display of spot soundings beyond a Safety Depth.

All three kinds of contours mark a depth contour that is equal or deeper to the assigned depths. For example, a safety contour is set as 15m. If there is no 15m contour on a chart currently viewed but there are 10m and 20m contours, the 20m contour will be selected.

Shallow Contour

Set the depth of the contour that is used to display the relief of the sea bottom just below the water surface. This depth must be shallower than the Safety Contour.

Safety Contour

Set the depth of the contour that should not be crossed to avoid grounding of the vessel. This contour appears thicker than other contour lines. This depth must be between the Shallow and Deep Contours.

Deep Contour

Set the depth of the contour beyond which all depths are considered deep enough to not warrant a lot of attention. This depth must be deeper than the Safety Contour.

Safety Depth

Spot sounding values shallower or equivalent to the Safety Depth are displayed in black color while spot soundings deeper than the set value will be displayed in grey color when Presentation Detail is set to Default or Full. When set to Minimal, spot sounded deeper than the set value will not be displayed.

More Chart Decoration Options

Two Shadows Only

When selected, only two shades are applicable: shallow waters and deep waters. The boundary is the Safety Contour (see above). Shallow and Deep Contours are not applicable. A depth area shallower than the Safety contour will be colored as the shallow water and a depth area deeper than the Safety contour will be colored as the deep water.

Shallow Pattern Used

When selected, a dedicated pattern will be applied to all depth areas shallower than the Safety Contour.

Anticluttering

When selected, clutter from chart labels and symbols will be reduced.

6.6. Local History Mapping™

The Local History Mapping™ feature in SonaSoft™ persists seafloor data received over the last hour of operation in the chart display. To generate the display, realtime data is 'gridded' into a regular Cartesian grid with 4 meter grid spacing. Data in the LHM display is corrected for tide height for customers with a valid C-MAP Professional+ license. The tide correction is a prediction based on historical data from the nearest tide station in the C-MAP Professional+ database to the vessels current position. Figure 47, "Local History Mapping Overlay™" depicts the LHM overlay on the chart viewer. Color is mapped to depth, where the blue and yellow ends of the scale represent a seafloor depth of 20 meters and 2 meters, respectively. The contours representing the channel are clearly visible in Figure 47, "Local History Mapping Overlay™" and in agreement with the underlying nautical chart. The vessel track history (see the section called "Track History Length") is also visible and shows the vessel's position throughout the duration of the survey.
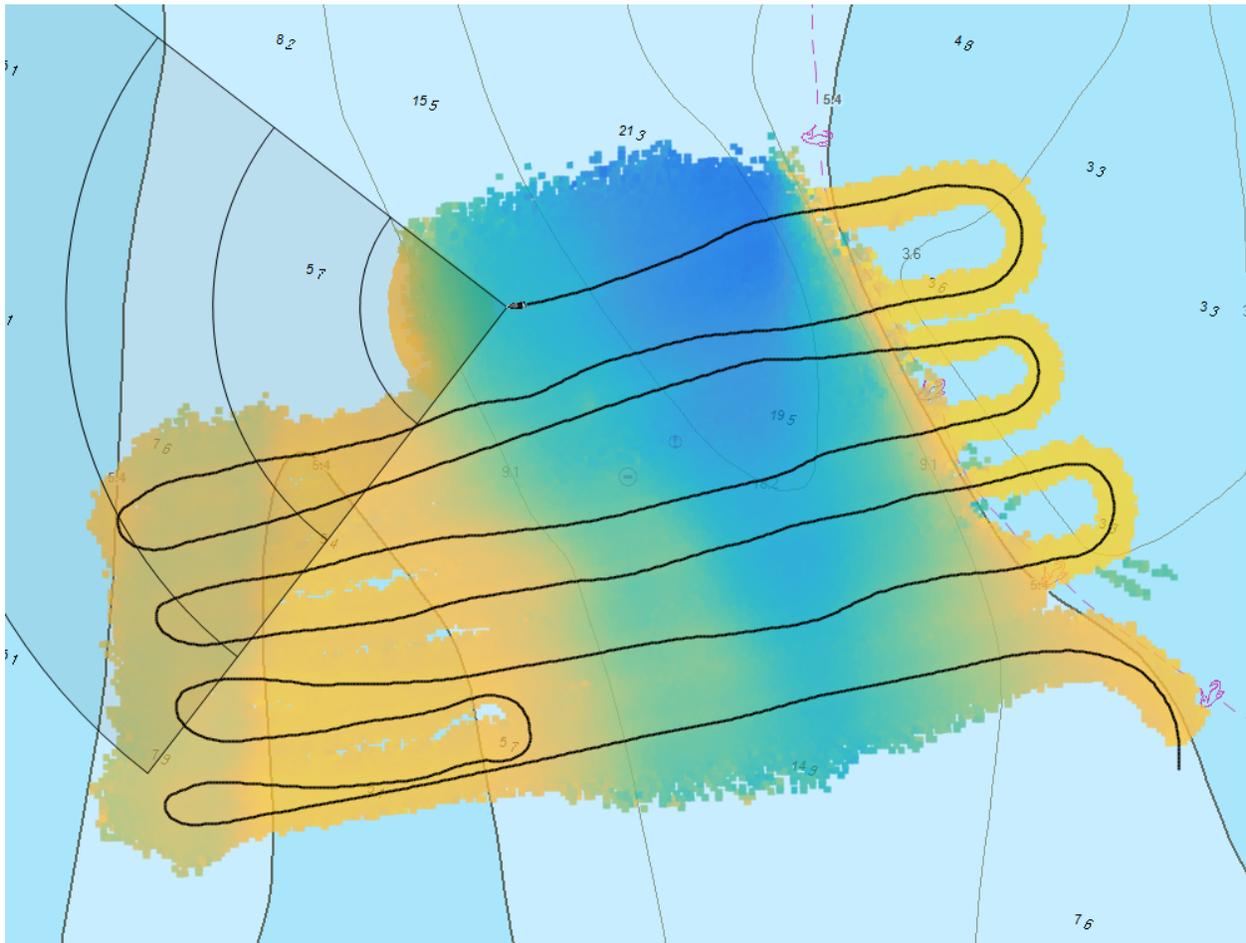
Figure 47. Local History Mapping Overlay™

6.7. Requirements

In order to take advantage of the chart dispaly in SonaSoft™, the following must be configured on each computer where the Chart Display will be used.

- C-MAP chart database must be installed. Currently supported databases are:

  - Professional+ database from C-MAP

- ENC databases from C-MAP

- S-57/63 charts

- C-MAP USB dongle must be installed. These can be acquired from FarSounder for a nominal fee.

- C-MAP license must be installed. This can be purchased through a C-MAP dealer or directly from C-MAP.

- Latitude and longitude data from a GPS and heading data from a gyro-compass or GPS compass must be input to SonaSoft™ via NMEA.

7. Nav Info Display

7.1. Overview

The Nav Info Display provides basic conning information (depth, heading, position, and speed) to the user in a text format when external NMEA sensors are connected to the SonaSoft™ user interface computer.

Sounder Depth	Heading	GPS
5.8 m	**118.7°** T	**41° 31.836' N** **071° 24.274' W**
Speed Over Ground	Rate of Turn	Course Over Ground
4.9 kn	**-24.0** °/min	**122.4°** T

Figure 48. The Nav Info Display

7.2. Configuration Manager Options

In order for this component to work properly, NMEA compatible depth, heading, GPS, and speed sensors must be connected to the SonaSoft™ user interface computer. These sensors include: echo sounder, GPS, gyro-compass, Doppler speed log, paddle wheel transducer, etc. More information on NMEA connections can be found in the chapter entitled Section 4.2, "Connecting NMEA Devices". Under the the Configuration Manager's NMEA Settings menu, the user can specify the type of NMEA message to use.

For echo sounder depth, the user can select from the following NMEA messages:

- DBT: Depth below transducer.

- DPT: Depth below the transducer with reference to keel or surface.

For vessel true heading, the user can select from the following NMEA messages:

- HDG: Heading, deviation, and variation.

- HDT: Heading true.

- VHW: Water speed and heading.

For vessel position, the user can select from the following NMEA messages:

- GGA: Global positioning system fix data.

- GLL: Geographic latitude and longitude.

- RMC: Recommended minimum specific GNSS data.

For vessel speed over ground, the user can select from the following NMEA messages:

- RMC: Recommended minimum specific GNSS data.

- VTG: Course over ground and ground speed.

Some messages provide speed in either knots or km/h. When available, the user can select the units they prefer.

For rate of turn, the user can select from the following NMEA messages:

- ROT: Rate of turn.

For course over ground, the user can select from the following NMEA messages:

- RMC: Recommended minimum Specific GNSS data.

- VTG: Course over ground and ground speed.

8. Using the Export Option

One of the options under the Configuration Menu is "Export". The export feature is used for sharing system data with FarSounder. When this feature is activated, a .zip file will be saved to the desktop containing:

- raw sonar data for the last few pings,

- SonaSoft™ log files, and

- all registry settings used by SonaSoft™.

The .zip file can be sent to FarSounder for evaluation. The contents will allow FarSounder engineers to see exactly what was seen on the vessel. It will also allow them to reprocess the raw sonar data with alternate settings.

9. Toggling Between Bow and Stern Nodes

For vessels with both Bow and Stern navigation sonars, the Configuration Manager includes a "Toggle Bow/ Stern" menu option. After selecting this option from the menu, the user must confirm the action by clicking on a pop up button. This prevents toggling by accidentally clicking on the menu option.

A. Understanding Water Depth Performance

Besides operating as a true 3D sonar, creating a 3D image with a single ping, FarSounder's technology distinguishes itself as a shallow water sonar system with its impressive Water Depth Performance and its ability to detect objects in shallow water even beyond its water depth limit. To best understand how FarSounder's technology is able to operate so well in shallow water it is first necessary to understand the metrics used in shallow water sonars.

There are two metrics used when talking about the maximum range of a forward-looking sonar: Maximum Range and Water Depth Performance. Both of these metrics are important, yet most other forward-looking sonar products do not like to talk about their Water Depth Performance.

Maximum Range is the farthest distance at which the system can detect targets under ideal conditions. This range is absolute and varies based on a target's acoustic reflectivity. Generally, larger objects have more reflectivity. However some materials and shapes also effect a target's acoustic reflectivity. In some cases, a "large" object who's material or shape does not reflect well will not be detected as well as "smaller" objects who's material and shape do reflect well. Good reflecting targets will be detected at the full range of the sonar. Weaker reflectors will be detected at shorter ranges.

Water Depth Performance is the ratio between the depth of water below the transducer and the range at which the sea bottom can be mapped. As an example, if a 2 water depth sonar system is operating in 50 feet of water, that system can generate bottom maps only out to 100 feet. Water Depth Performance is limited by various physical effects and the bottom mapping range of a sonar is primarily a function of the water depth below the transducer.

Forward looking sonars, by definition, send much of their transmitted energy forward with varying downward (and/or upward) angles. When the down angles are steep with much of the energy pointed towards the seafloor, a large percentage of the energy is reflected back to the sonar's receiver, though some of the energy is reflected forward just like light bouncing off a glass mirror. The energy bouncing back to the sonar is aptly called "back-scatter" while the energy bouncing forward is called "forward-scatter".

As the down angle becomes more shallow, the amount of back-scatter decreases as the forward-scatter increases. The actual ratio of back-scatter to forward-scatter for a given angle varies slightly with sea bottom composition. If the seafloor is rough, relative to the size of the acoustic wavelength, then there are more "edges" on the seafloor that are reflecting back towards the sonar. If the seafloor is comparatively smooth, then the seafloor acts more like a true reflecting mirror. Hard rough sea bottom materials like rocks and sand reflect better than soft materials like mud and silt. Figures A.1-A.3 illustrate this point.
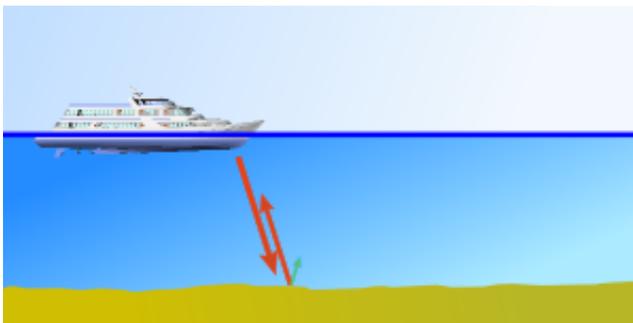
Figure A.1. Reflections from a steep angle
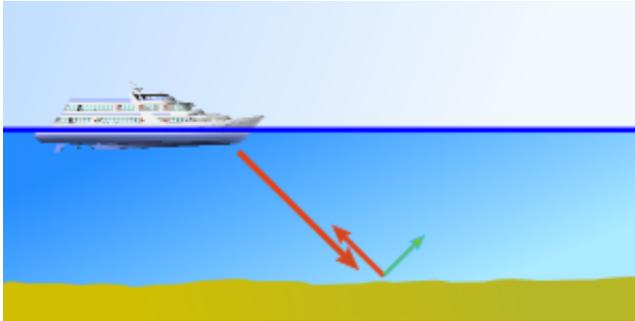
Figure A.2. Reflections from a medium angle
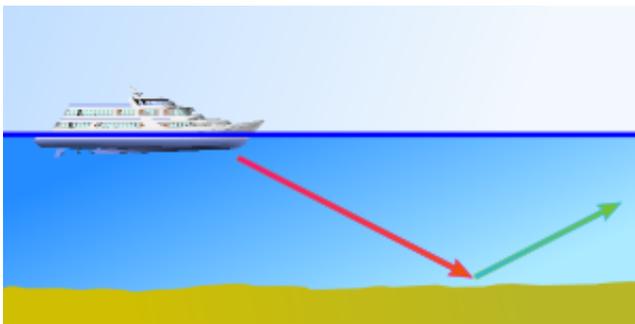
Figure A.3. Reflections from a shallow angle

In reality, the situation is actually quite a bit more complicated as the sound waves reflect not only off the seafloor but also off the sea surface - sometimes more than once! (see figure A.4) This type of bouncing is called multipath propagation.
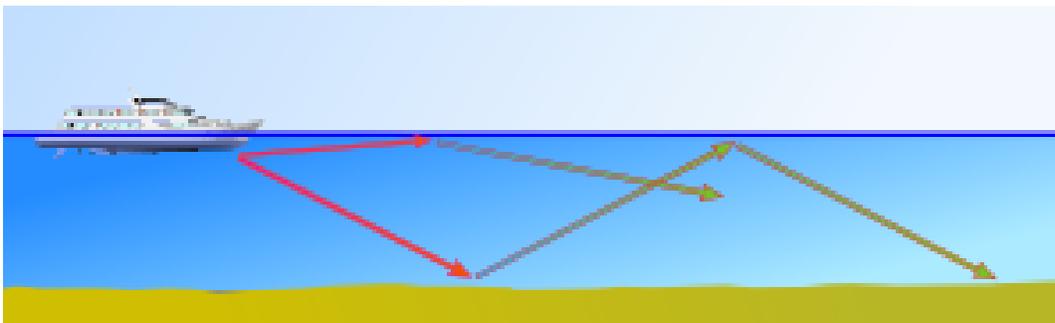
Figure A.4. Multi-path reflections

Differing levels of sophistication enable various navigation sonar products to extract back-scatter reflections from the seafloor at differing minimum echo levels. This directly defines the water depth limit at which a particular sonar can produce bottom maps ahead of the vessel. As range increases, the angle at which the incoming sound wave hits the seafloor becomes shallower. At some angle, not enough energy is reflected back to the receiver to allow for sea bottom detection and mapping. The FarSounder-500 and FarSounder-1000 products are specified as 8 water depth sonars. This means they can map the seafloor out to a range equal to 8 times the depth below the transducer. Depending on the actual local propagation conditions and the seafloor composition, this range may be longer or slightly shorter.

One of the most impressive features of FarSounder's technology is its shallow water capability. Though FarSounder's products are specified as 8 Water Depth systems, 10+ Water Depth performance can sometimes be achieved in certain conditions. However, even beyond their water depth capability, FarSounder sonars are still able to detect objects out to farther ranges. This seems obvious for objects

floating in the middle of the water column. However, even obstacles laying on the seafloor can reflect well beyond the bottom mapping limit. To illustrate this case, consider a rock on the seafloor as shown in figure A.5. The rock creates a reflecting surface that is able to angle the reflected signals back to the sonar rather than forward-scattering them away from the sonar. It may not be possible to tell the exact depth of that obstacle, but it can be clearly detected as an in-water target.
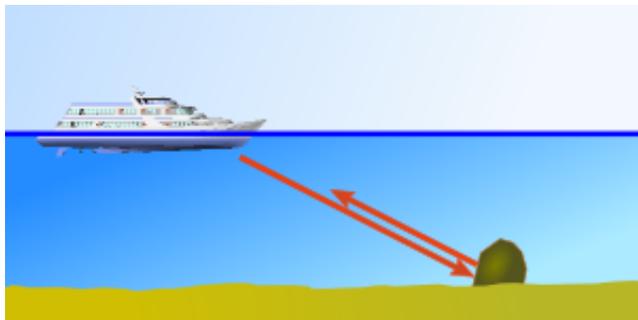
Figure A.5. Reflecting off an in-water target beyond bottom mapping range

The ability to detect obstacles beyond a sonar's water depth limit is extremely important. Vessel operators can detect the edge of rock ledges, shore lines, submerged coral reefs, and other navigation hazards. This is helpful even in charted areas. For example, charts often mark an area as "reef" or "rocks" but don't give the exact locations. Sometimes channel markers are missing or have moved from their nominal locations on the chart. The sonar can help the vessel operator know exactly where their ship is located relative to the edge of the channel.

Please visit the screen shots gallery at http://www.farsounder.com for examples of shallow water operation at ranges well beyond our water depth capability.

B. Ping-to-Ping Target Stabilization

1. Overview

As described in Appendix C, *Understanding Interference and Other Limitations*, sonar technology is limited in what it is able to detect and ocasionally susceptible to interference. Because of this, SonaSoft™ performs ping-to-ping processing to mitigate these effects. This processing tracks in-water targets over time to create an expectational model of the underwater environment which, in turn, is then used to provide a much more stable image. This is similar to persistence found on radar systems.

There are two primary effects of this ping-to-ping stabilization that should be noted when operating SonaSoft™. The first is noise filtering, and the second is gap filling.

2. Noise Filtering

SonaSoft™ hides all targets the very first time they are detected, waiting until their second detection to display them. This significantly reduces the number of false-detections caused by transient noises such as wave slaps, engine noise and fleeting bubbles. However, it is also important to be aware that if a true target that you are expecting to see is not displayed, it may be because SonaSoft™ is still determining its reliability. Typically, waiting one ping is long enough to resolve any unexpected behavior caused by this noise filtering.

3. Gap Filling

Because targets may become temporarily obscured at certain orientations or hidden behind schools of fish or bubble clouds, the sonar may ocassionally fail to detect a target. Because of this, SonaSoft™ will display a synthetic target where the actual target was expected to have been seen, filling in what would have otherwise been a "gap". SonaSoft™ will only fill these gaps for a maximum of 5 pings before determining that those expected targets are no longer reliable.

C. Understanding Interference and Other Limitations

1. Overview

FarSounder has developed advanced signal processing algorithms that allow the software to operate largely without significant user input. These algorithms represent the state of the art in forward looking, obstacle avoidance sonar technology. However, like any shipboard tool, forward-looking sonar will not solve every problem 100% of the time. It will, however, solve many problems most of the time. It is therefore important to accurately understand how interference and other limitations affect the system's performance.

2. Other Sonar Interference

FarSounder's sonars operate at around 60 kHz. The most common echo sounder frequency is 50 kHz. Since these frequencies are close to one another, users may sometimes experience interference from other sonars. Generally, interference is only experienced when the echo sounders on large commercial ships are close to the user's vessel and when the FarSounder is pointed towards the other ship. Such interference appears on the FarSounder display as partial or whole "rings" of echoes all at the same range as shown in figure C.1. Usually, they appear as in-water targets, but sometimes they can also appear as a raised mound or sharp dip in the sea bottom at all angles. The interference can also be seen in the System Status's Hydrophone Data display as shown in figures C.2 and C.3. In this view, the interference appears as sharp "spikes" in the signal at regular intervals. Generally, between 6 and 20 spikes will be present at a time in the Hydrophone Data Display. It is important to realize that if another vessel is interfering with the FarSounder sonar, this usually means the area is well trafficked and often well known. In locations where the FarSounder sonar is most valuable, echo sounder interference is usually not present. Generally, the FarSounder will not interfere with echo sounders.
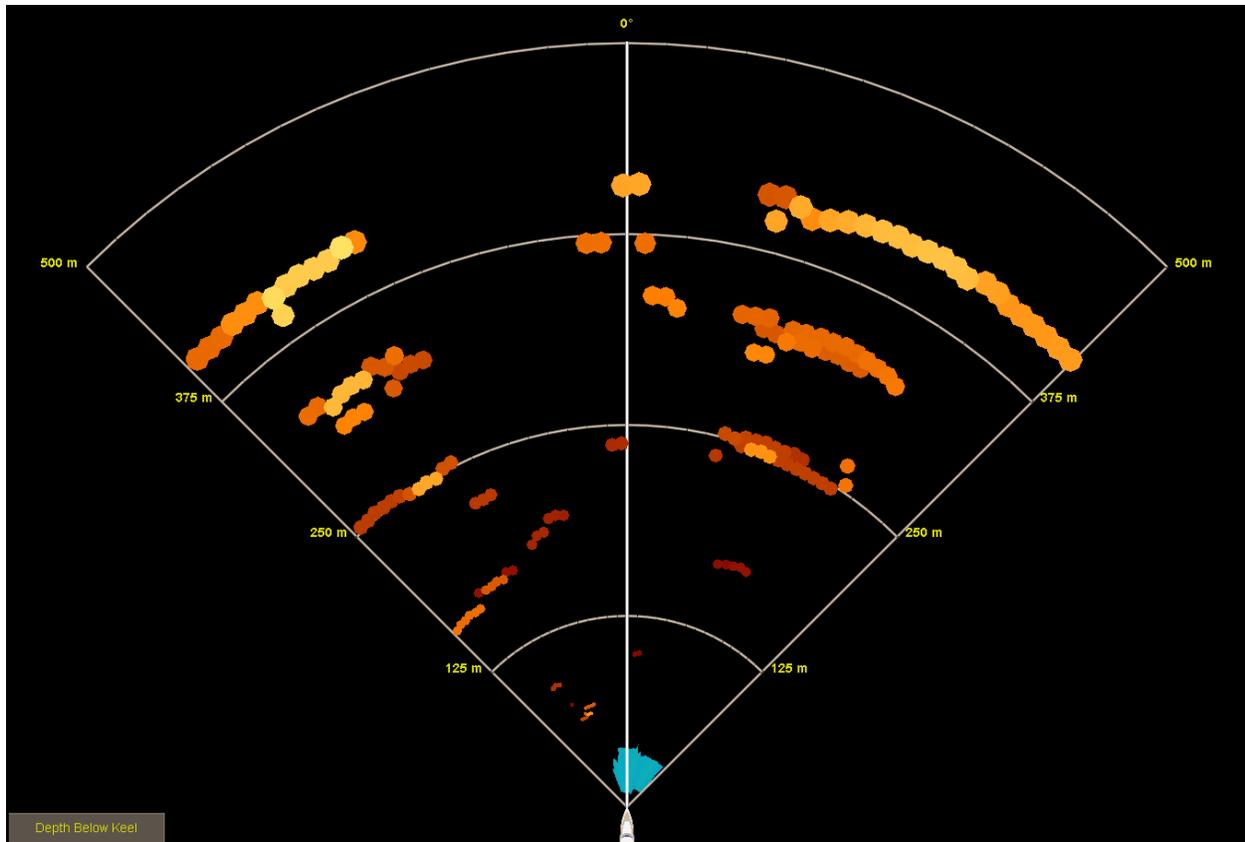
Figure C.1. Echo sounder interference as seen in the 3D Sonar Display

Dolphins and porpoise are another source of interference similar to echo sounders. When dolphins or porpoise are near the vessel or playing in the bow wake, interference will often be present. This is from the animals' own sonar systems pinging back at the FarSounder sonar. Though FarSounder's sonars operate outside the hearing ranges of the great whales, dolphins and porpoises can hear the transmissions just as they do those of echo sounders. FarSounder has taken great care in ensuring that their sonars will not cause any harm to any marine life. The duty cycles and transmit powers are significantly lower than those of other marine acoustic systems that are commonly accepted throughout the world. In fact, FarSounder's products have been reviewed by scientists at the National Marine Fisheries Service and been found to have no negative impact on the marine environment [1].

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[1] "NOAA's Ocean Acoustics Program (NMFS Office of Science and Technology) has assessed the technical specifications of the current version of the FarSounder sonar technology and concurs that, based on the sound source level, signal duration, directionality, and operational frequency band, there are no anticipated injurious effects on marine mammals or other marine species from it's deployment." --Brandon Southall, NMFS
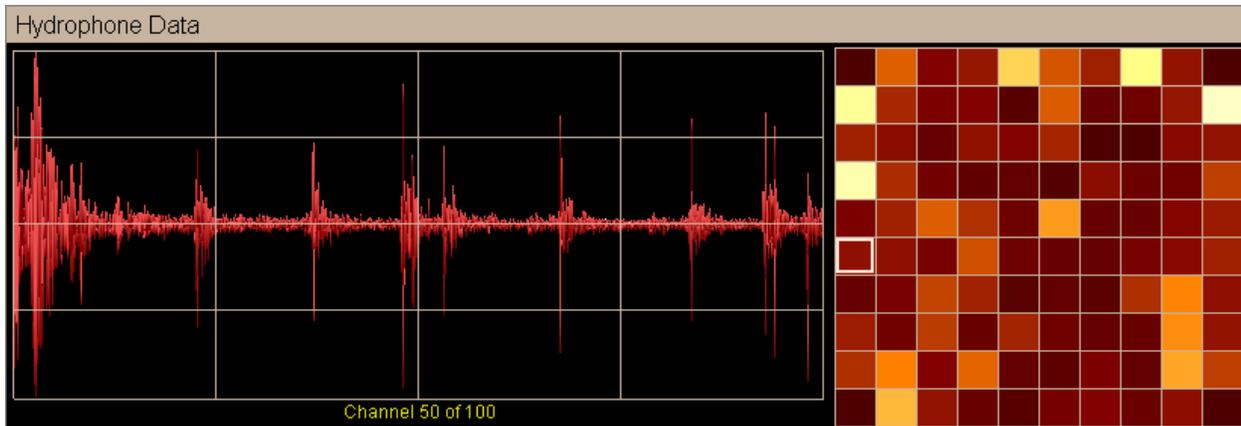
Figure C.2. An example of echo sounder interference as seen in the Hydrophone Data display
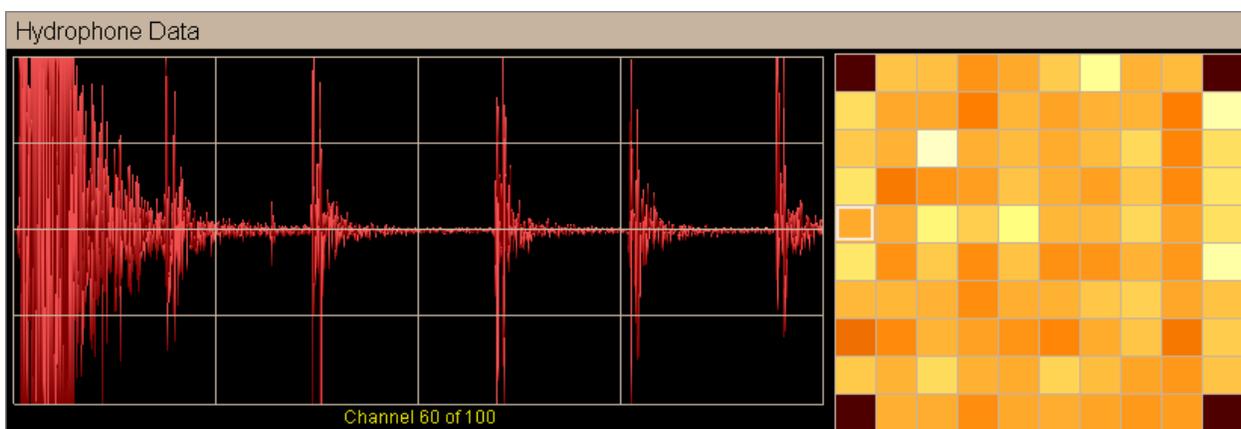
Figure C.3. An example of echo sounder interference as seen in the Hydrophone Data display

3. Bubble Cloud/Wake Interference

Bubbles make really good sonar reflectors. This means that bubbles will interfere with any sonar by creating echo returns at the bubble's location and blocking sound from passing through a bubble cloud. This effect is not unique to FarSounder sonars. Rather this effect is true for all sonar technologies. Bubble clouds consisting of large bubbles tend to reflect echos back to the sonar and prevent sound energy from continuing beyond the bubble cloud. Bubble clouds consisting of small bubbles tend to dissipate the sound energy by dispersing the echos in many directions. They also prevent sound energy from continuing beyond the bubble cloud, but they don't generally reflect a lot of echo back to the sonar. In both cases, the larger the bubble cloud, the more energy from the sonar is disrupted. Bubbles are produced by a variety of things such as waves, vessel wakes, and turbulent current flows around stationary objects like pilings and buoys. Each of these types of bubbles clouds will effect FarSounder sonars differently.

Waves produce bubbles by forcing pockets of air down into the water column as the waves splash and break. The bigger the waves, the more air bubbles will be pushed deeper into the water. It turns out, that most bubbles from most waves most of the time in most waters are in the upper 6 feet of the water column. This means that the deeper the sonar is installed on the vessel, the better the system will perform in worse sea conditions. Bubbles created by waves will often show up as in-water targets. They will be transient (meaning they do not always show up in the same place) and will often be slightly less reflective than large navigation obstacles. Like radar, higher sea states will cause more interference with the sensor. Like increasing a radar's wave reject setting, increasing the sonar's In-Water Squelch setting a few decibels will often remove much of the wave induced "noise" reflections. Also like radar, this will have the cost of

not detecting actual smaller objects. It is recommended that the user view the 3D Sonar Display with color mapped to Signal Level to best determine the general reflectivity level of the wave induced bubbles. From this, the user can set the In-Water Squelch appropriately.

Vessel Wakes are another source of bubbles. Their bubbles are created by the hull forcing air into the water as the vessel cuts through the water and by the propulsion system creating cavitation. Vessel wakes generally reach a depth no greater than the draft of the vessel from which they were created. These bubbles clouds tend to be a mixture of large and small bubbles. The larger bubbles reflect strong echoes back to the sonar and dissipate relatively quickly (generally within a couple of minutes). The smaller bubbles tend to disburse the sonar energy without reflecting many strong echoes back to the sonar. They dissipate slowly and can be trapped in the water for 10 minutes or more. Generally, if the path of the vessel is still visible at the surface of the water, wake induced bubbles are still present.

Figure C.4. Wake interference

From far away, vessel wakes generally appear on the sonar as a long line of in-water targets similar to a jetty or pier wall. However, once the sonar enters the wake area, normal operation will generally be disrupted since the bubbles are blocking the outgoing transmit energy directly at the transducer. When inside a wake, the Hydrophone Data viewer inside the System Status Display will show a short period of strong energy followed by a period of almost no energy. Figure C.4, "Wake interference" shows an example of the sonar inside a wake. The short, strong energy seen is the transmit signal as it passes through the transducer before the bubbles block the signal. Once the sonar passes through a wake, normal operation will resume.

Turbulent Current Flows around stationary objects like pilings and buoys produce bubble clouds mostly through cavitation. In general, these bubble clouds consist of small to medium sized bubbles. This means that sometimes the object in the water creating the turbulence will be masked by the small bubbles dissipating the sound with few strong reflections back to the sonar. Generally, this effect will only be seen when approaching such objects from down current. In other situations, the mediums sized bubbles will dominate and the sonar will detect a slightly fluctuating "tail" to the actual object. Like wakes, if the sonar enters a turbulence field, normal operation of the sonar will generally be disrupted until the sonar passes through the turbulence.

4. Sea State Limitations

In addition to creating bubbles, increased sea states can have additional effects on the sonar system. The most obvious is transducer movement. Inside the Transducer Module is a roll and pitch sensor. This sensor will significantly stabilize the image shown to the user when the vessel is undergoing rolling and pitching up to 20 degrees. Though the Transducer Module should stay submerged, should heavy pitching bring the unit out of the water occasionally, the unit will not be damaged. However, should the unit be transmitting or receiving during that period, no image will be seen. Additionally, if the unit is in the water and a wave trough

is between the sonar and a target of interest, the trough will block the sonar from "seeing" the target. The sonar works as a line of sight system and sonar energy cannot cross the water/air boundary.

5. Vessel Speed Limitations

The FarSounder-500 and FarSounder-1000 sonars are designed for use at vessel speeds up to 20 and 25 knots respectively. This rating is based upon an ideal installation where vessel induced mechanical vibration noise is not present. Some vessels have significant mechanical vibration or create turbulence in front of the Transducer Module. In these cases, system performance may degrade at speeds less than the stated maximums. Going beyond these speeds will not damage the system. However, at higher speeds, performance will decrease as speed increases. That being said, some FarSounder customers have reported good performance even at speeds over 25 knots.

D. Maintenance

1. Overview

Your FarSounder sonar system has been designed with minimum maintenance requirements. However, like any shipboard system, it is important to periodically check the status of the system. This section of the manual outlines the recommended maintenance procedures and schedule for FarSounder's sonar systems.

2. Every 3 Months

Inspect the Transducer Module(s) for marine growth. Depending on the local marine environment and the amount of time the vessel is underway, the array face of the Transducer Module may become biologically fouled. This fouling is a build up of marine life such as barnacles and algae growing on the urethane array. Fouling will dampen the power of the transmit signal and reduce the sensitivity of the received echoes. If fouling is present, it can be scraped off with a simple paint scraper or the handle of a wooden paintbrush. When cleaning the Transducer Module's array face, it is important that the urethane is not damaged.

Inspect the Transducer Module(s) for corrosion. A properly installed Transducer Module will be connected electrically to the vessel's ground and local zincs. In these cases, there should be no corrosion even after extended periods of in-water deployment. If corrosion of the metal is detected, it is important that the Transducer Module's connection to local zincs are confirmed and if necessary, add additional local zincs to the Transducer Module's mounting bolts. Unchecked corrosion will eventually lead to failure of the Transducer Module's pressure case and non-warranty damage to the unit.

3. Every 6 Months

Inspect and clean the fans on the processing computer(s) and Power Module(s). A build up of dust and debris will reduce the effectiveness of these components. Replace any fans as needed.

E. Troubleshooting

1. Overview

The development team at FarSounder has worked hard to create robust, reliable products. However, as with any piece of complex marine equipment, there is always the chance of something unexpected happening. FarSounder technicians and and engineers are always willing to work directly with our customers and dealers to resolve any issues as quickly as possible.

The first step in resolving any issues is understanding what is happening. Checking the following items is often helpful in pinpointing the exact problem.

1. Did the issue suddenly appear or has it always been present?

2. Is the user interface software able to communicate with the sonar hardware?

3. What are the results of the Power Module LED diagnostics?

2. Power Module LED Descriptions

Current Power Modules are equipped with seven LED lights on the front faceplate (six LEDs on older models). These lights show the status of the Power Module and sonar, and are very useful when troubleshooting the system. Here is a short description of what each LED signals:

* *Power*: Indicates that the Power Module has power.

* *Bank 1*: Indicates that one of the two large amplifier capacitors is charged.

* *Bank 2*: Indicates that the other of the two large amplifier capacitors is charged.

* *Ping*: Indicates that the transmit amplifier is generating an output ping.

* *CTRL A* and *CTRL B*: Indicate states of the Output Select lines coming from the Transducer Module

* *TX ON/OFF*: Indicates if the amplifier circuit for the sonar's transmitter is enabled of disabled. When enabled, the LED is off. When disabled, the LED is RED. Note that units are shipped with the TX set to OFF and must be set to ON during commissioning.

3. Power Module LED Diagnostics

The state of LEDs on the Power Module can often provide insight into any issues that may be occuring with the sonar's electrical system. The following procedure can help diagnose some hardware issues.

1. Turn off the Power Module. Wait ~30 seconds for all LEDs to turn off.

2. Unplug the ethernet cable from back of the Power Module.

3. Turn on the Power Module. What do the LEDs show at power up?

4. Wait ~10 seconds (~90 seconds for FS-3DT) for the system to boot. What do the LEDs show after booting?

The table below describes some of the LED indications. Please note that the "LED State" column contains one circle indicator for each LED light. Possible values for each indicator are as follows:

- ●: The light is off.

- ○: The light is on.

- ☼: The light is flashing.

- ◐: The light may be on or off.

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4. C-MAP Chart Display Missing Data Around Border

If the C-MAP chart display appears to be missing data near the borders of the display, C-MAP may have been configured on a screen with a resolution different from that of the current monitor. The solution is to recalibrate C-MAP so that it is configured for the resolution of the currently connected monitor.

To recalibrate C-MAP for the current screen resolution:

- Run the C-MAP ruler program. It can be found in: `C:/Program Files (x86)/C-Map Professional SDK Runtime/Ruler.exe`

- Inside the ruler tool dialog, click the "Measure the Screen" button.

- A white square will appear. Measure this square with a ruler, enter the resulting measurements and click "Ok".

The C-MAP is now properly configured for the resolution of the current monitor and SonaSoft™ should be restarted. If the problem persists, please contact FarSounder™ technical support.